EUS of the neck: A comprehensive anatomical reference for the staging of head and neck cancer (with videos)

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ABSTRACT

The use of EUS has application in the nodal staging of head and neck cancer. The technique and the anatomy of head and neck region using EUS have not been described. EUS from three stations in thoracic esophagus, cervical esophagus, and hypopharynx can allow imaging of head and neck. In this article we describe the normal structures from the three stations. The EUS imaging of head and neck can give relevant and additional information in malignancies of head and neck.

Key words: EUS, esophagus, hypopharynx, malignancy, neck

BACKGROUND

Sonographic imaging of the head and neck is often difficult due to the anatomical complexity; hence, computed tomography (CT) and magnetic resonance imaging (MRI) are usually performed as the imaging techniques of the first choice for assessing the extent and nature of the diseases of this region.[1] However, ultrasonography (US) is still an integral part of the routine diagnosis, treatment, and follow-up of diseases of the head and neck.[2,3] A major advantage of US, apart from being highly sensitive and nonionizing, is that the attending physician gets the "big picture," when he performs the examination himself.[4] Each malignancy of head and neck has its unique first echelon and pattern of spread to different nodal stations.[5] Although nowadays positron emission tomography-CT (PET-CT) is playing an increasingly important role in the detection of pathologic lymph nodes (LNs); a cytopathological confirmation is possible only by CT- or US-guided fine needle aspiration (FNA).[6-8] EUS adds value during esophageal and lung cancer staging.[9-12] Little information is available regarding the use of EUS and

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EUS-FNA aspiration cytology (EUS-FNAC) to stage tumors in the head and neck region.[13-15] No specific probe has been developed for EUS evaluation of the head and neck region.[16,17] EUS with the help of a modified probe has shown results superior to CT and MRI in the assessment of laryngeal cancer.[1,3] A special advantage of EUS examination is that the flexible probes can be used for EUS-FNAC of LNs or masses not accessible to CT or ultrasound.[11,12,18] The aim of this article is to present the techniques and limitations of EUS in the diagnostic evaluation of structures and LNs of the head and neck.

TECHNIQUES OF IMAGING

EUS examination of structures of the neck can be done on outpatient basis after conscious sedation using intravenous midazolam and oral xylocaine (10%) spray. The images in this article were procured with a linear echoendoscope (Pentax EG 3830 UT) using Hitachi Avius-processor. Imaging can be done from three stations: the upper part of thoracic esophagus, the cervical esophagus, and the hypopharynx. The scope is generally unstable near the pharyngoesophageal junction; hence, the examination is started after inserting the echoendoscope into the upper part of thoracic esophagus (Station 1). Subsequent withdrawal is done to cervical esophagus (Station 2), and the last part of the examination is done from hypopharynx (Station 3) [Figures 1, 2 and Videos 1, 2].

Six home bases

A home base is a structure, which can be easily found by manipulation of the scope if the orientation is lost during imaging. The six main home base structures that can be identified at three stations are arch of aorta, trachea, spine, sternocleidomastoid muscle, thyroid gland, and the great vessels of the neck.

The movements

Imaging of structures is done after the apposition of the probe against the wall. A 360° clockwise or anticlockwise rotation is done to change the axis of imaging. In general, a rotation of the scope done in such a manner that it showed structures posterior, lateral, or anterior to the scope in a sequential manner during rotation [Figures 1a and 2]. For uniform description in this article, the structures are described while doing a clockwise movement after doing a maximum anticlockwise rotation and visualization of spine, which is a structure in posterior relation to the esophagus and pharynx.

The orientation

A cranial part of image to the right and caudal part of image to the left convention is followed, and examination is done in three steps [Figure 3a]:

i. Identify home base
ii. Identify anatomic landmarks
iii. Identify LNs.

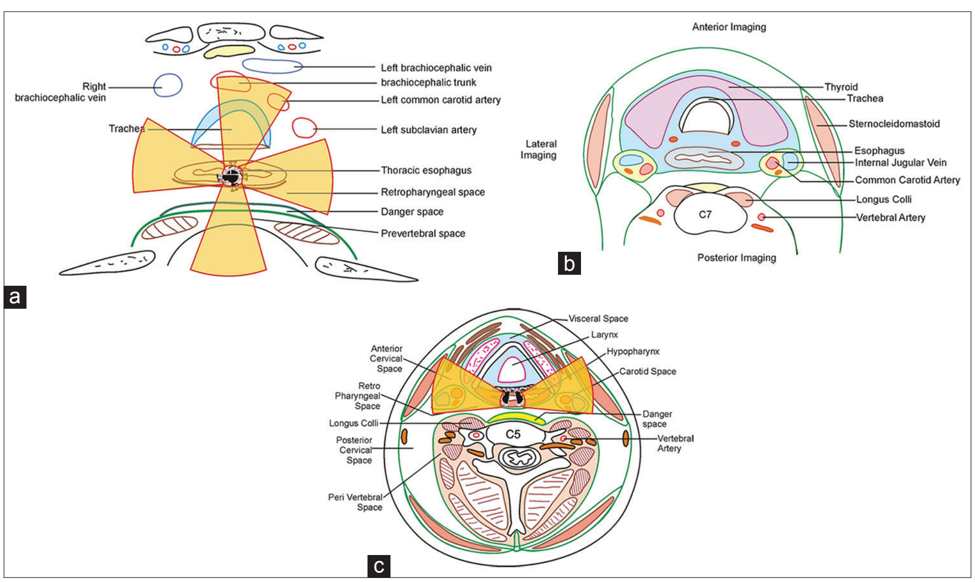

Figure 1. (a) The areas seen on anterior lateral and posterior imaging from the thoracic esophagus. (b) The areas seen on anterior lateral and posterior imaging are seen from the cervical esophagus. (c) The areas seen on anterior lateral and posterior imaging from hypopharynx. The structures of hypopharynx are enclosed within three layers of cervical fascia, *i.e.*, a superficial, a pretracheal, and a prevertebral fascia. The superficial layer surrounds all the important structures in the neck; the prevertebral layer surrounds the vertebral column and the muscles; and the pretracheal layer forms a visceral compartment, which include thyroid, pharynx, esophagus, and trachea

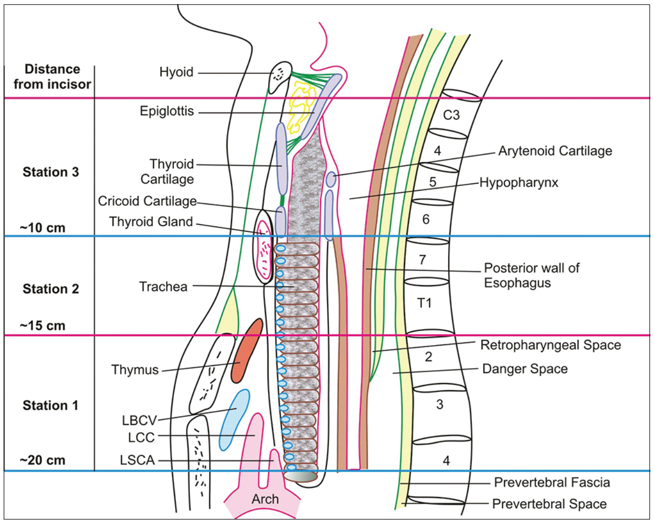

Figure 2. Schematic sagittal section showing the three stations from which EUS examination can be done. The examination from Station 1 is done from thoracic esophagus, which extends from arch of aorta to suprasternal notch. The examination from Station 2 is done from cervical esophagus, which extends from suprasternal notch to lower border of cricoid cartilage and examination from Station 3 is done from hypopharynx, which extends from cricoid cartilage to hyoid bone

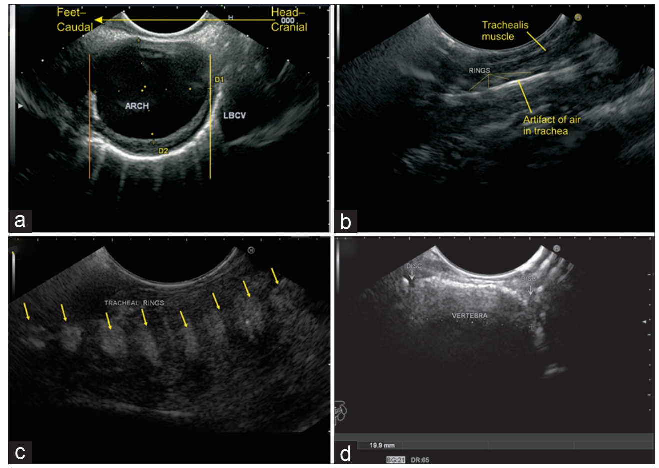

Figure 3. (a) Initially, the upper border of arch of aorta is located. The arch of aorta is about 2 cm in diameter and identified approximately at 20–22 cm distance from incisor. (b) The trachea lies in front of esophagus and the presence of air in trachea interfere with imaging during EUS. The trachealis muscle lies in the posterior wall of trachea. The sound waves are transmitted through the muscle, and reverberation artifact of air in the lumen of trachea is produced as a white line in front of esophagus. Even in this image, small areas of cartilage are seen in the posterior wall of trachea. (c) On a clockwise rotation to either side, the rings of the trachea can be more easily appreciated (yellow arrows). (d) The alternating pattern of hyperechoic spine and hypoechoic intervertebral disc can be traced all the way to the base of skull by a pullout along the posterior wall of esophagus and pharynx

Station 1: Thoracic esophagus

Identification of home bases

The arch of aorta, the trachea, and the spine. The arch of aorta is easily identified at about 20–22 cm distance in the thoracic esophagus as a circular anechoic vascular structure of 1.5–2.0 cm diameter [Videos 3 and 4]. A clockwise rotation from this position takes the imaging plane anteriorly toward the trachea and anticlockwise rotation from this position takes the imaging plane posteriorly toward the spine. The trachea is identified by the presence of air and cartilage in the wall of the trachea, both of which create prominent artifacts [Station 1, Figure 3b and c].

Identification of anatomic landmarks

Posterior imaging

The spine creates a hyperechoic artifact, and the hypoechoic intervertebral discs are seen between two hyperechoic vertebrae [Figure 3d].

Lateral imaging

On clockwise rotation from the spine, the descending aorta is identified, and the upper margin of the arch of aorta is identified after tracing the descending aorta to the highest point with slight clockwise rotation of the scope.

Anterior imaging

On further clockwise rotation, the origin of the left subclavian artery left common carotid artery, and brachiocephalic trunk can be seen from the upper border of the arch of aorta [Station 1, Figure 4a-d]. The left subclavian artery, which goes close to apex of lung commonly, creates a mirror image artifact. The left common carotid artery runs close to the left wall of the trachea and the brachiocephalic trunk crosses to the right side of the trachea. During the clockwise rotation of the echoendoscope, the imaging axis passes from the left common carotid artery to the trachea, and it is difficult to visualize the brachiocephalic trunk by EUS scope. The left brachiocephalic vein (LBCV) crosses from the left to right side in front of great vessels of neck.

Identify lymph nodes

The EUS scope provides a good visualization of nodes in this position. Pathological LNs can be evaluated for metastatic disease by EUS-FNA.

Station 2: Cervical esophagus

Identification of home bases: The great vessels of the neck, the thyroid gland, and the sternocleidomastoid muscle

In this position, an ultrasound probe placed externally from the neck reveals the good quality of images to an ultrasonographer. The scope is in an unstable position for EUS-guided FNAC in this position. The cervical LNs in this position can be also visualized from the neck, and it is generally recommended to do

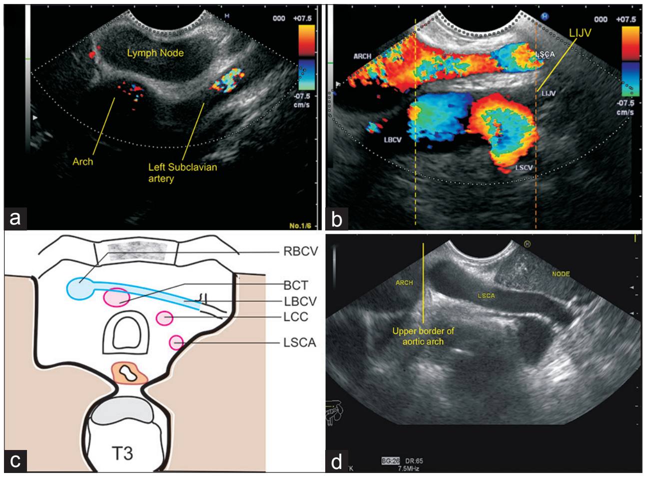

Figure 4. (a) The examination of arch of aorta shows the origin of left subclavian artery and a lymph node belonging to a metastatic station of head and neck malignancy. (b) The EUS image shows the origin of the left subclavian artery from the arch of the aorta. The formation of the left brachiocephalic vein is observed by the union of the left internal jugular vein and left subclavian vein near the lower part of supraclavicular triangle. In general, the venous system is larger and lies more laterally and is observed beyond the left common carotid artery in this image. The yellow line represents the upper border of aortic arch, and the orange line shows the lowermost point of supraclavicular triangle. (c) The left brachiocephalic vein crosses in front of the left subclavian artery, left common carotid artery, and brachiocephalic trunk to join the right brachiocephalic vein. (d) The aortopulmonary window is not routinely included during imaging from upper esophagus. In linear imaging from upper esophagus, the arch of aorta can be seen which indicates the lower limit of Station 1. An expanding view of linear scope shows multiple lymph nodes in the aortopulmonary window just below the lower border of arch of the aorta. LBCV: Left brachiocephalic vein; LCC: Left common carotid artery; LIJV: Left internal jugular vein; LSCV: Left subclavian vein; BCT: Brachiocephalic trunk; RBCV: Right brachiocephalic vein; LBCA: Left brachiocephalic artery

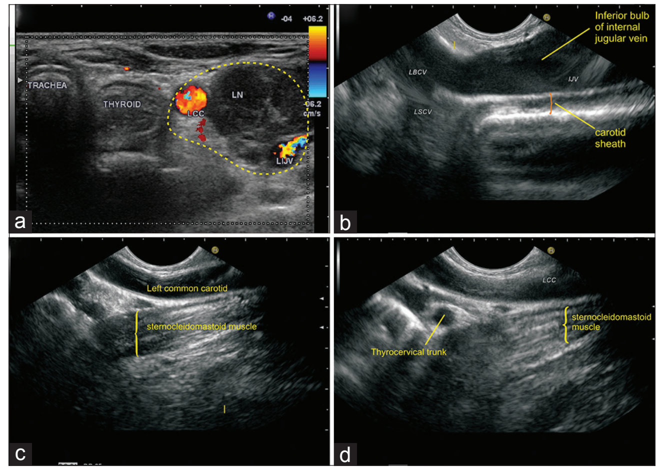

Figure 5. (a) This image is not an EUS image. It is an external ultrasound image which has been included to clarify the anatomical landmarks visualized during EUS. The dotted outline shows the area of the carotid sheath. Anterior (Central) compartment Group VI lymph nodes include the pre- and para-tracheal nodes, the precricoid (Delphian) node, and the perithyroidal nodes. The superior boundary is the hyoid bone. The trachea and the thyroid mark the anterior compartment. A transverse section of ultrasound from the neck shows the thyroid gland and a lymph node lateral to thyroid gland between the left common carotid and left internal jugular vein. The lower jugular group consists of lymph nodes located around the lower third of the internal jugular vein extending from the inferior border of the cricoid (above) to the clavicle (below). (b) The union of the two vein is seen in the base of the neck, and the dilated lower part of the internal jugular vein is called as the inferior bulb. The carotid sheath is made of contribution from pretracheal, precervical, and superficial fascia. Upper Jugular Group is comprised lymph nodes located around the upper third of the internal jugular vein extending from the level of the skull base (above) to the level of the inferior border of the hyoid bone (below). The middle jugular group consists of lymph nodes located around the middle third of the internal jugular vein extending from the inferior border of the hyoid bone (above) to the inferior border of the cricoid cartilage (below). (c) The left common carotid artery lies in the carotid sheath in anterolateral relations to esophagus and the sternocleidomastoid muscle lies lateral to the carotid sheath. (d) The thyrocervical trunk is a branch of the subclavian artery arising from the first portion of this vessel, *i.e.*, between the origin of the subclavian artery and the inner border of the scalenus anterior muscle. LBCV: Left brachiocephalic vein; LSCV: Left subclavian vein; LCC: Left common carotid; LIJV: Left internal jugular vein; IJV: Internal jugular vein

direct ultrasound or CT-guided FNAC from the neck [Station 2 and Figure 5a]. Once the echoendoscope is placed inside the cervical esophagus, the great vessels of the neck are easily identified and traced cranially into the carotid sheath within the carotid triangle [Station 2, Figure 5b and Video 5]. The sternocleidomastoid muscle is seen on the far side of the carotid triangle [Station 2, Figure 5c and Video 6]. A clockwise rotation from this position takes the imaging axis sequentially toward the left lobe of the thyroid gland, trachea, and the right lobe of the thyroid gland.

Identification of anatomic landmarks

Posterior imaging

Maximum anticlockwise rotation identifies the spine posteriorly. Slight clockwise rotation identifies the longus colli muscle along with the vertebral artery. The vertebral artery is seen in an area between the two adjacent transverse processes of vertebrae. The transverse processes interrupt the visualization of the entire course of the artery.

Lateral imaging

Further rotation identifies the sternocleidomastoid muscle and the appearance of structures within the carotid sheath. A clockwise rotation beyond the common carotid artery moves the imaging beam toward the anterior compartment. An outward pull shows the course of the left common carotid artery, which enters the carotid sheath. In this position, the branch of subclavian artery (thyrocervical trunk) can be seen in the triangular area between the probe and sternocleidomastoid muscle in the supraclavicular fossa [Station 2, Figure 5d and Video 7]. The union of LBCV and internal jugular vein marks the lowest boundary of supraclavicular fossa [Station 2, Figure 6a-d and Video 8]. The LBCV is seen to cross in front of the great vessels of the neck [Figure 6a]. The course of left subclavian artery can be followed up till it arches and enters the supraclavicular triangle and the arching part of subclavian artery is easily visualized [Station 2, Figure 6b and Video 9]. Even with EUS, it is occasionally possible to see the brachiocephalic trunk taking origin from the upper part of the arch of aorta and to trace the course till the division into right common carotid and right subclavian artery. Sometimes, it is possible to see the joining of the thoracic duct in the angle between the joining of LBCV and left subclavian vein [Station 2, Figure 6c and Video 5].

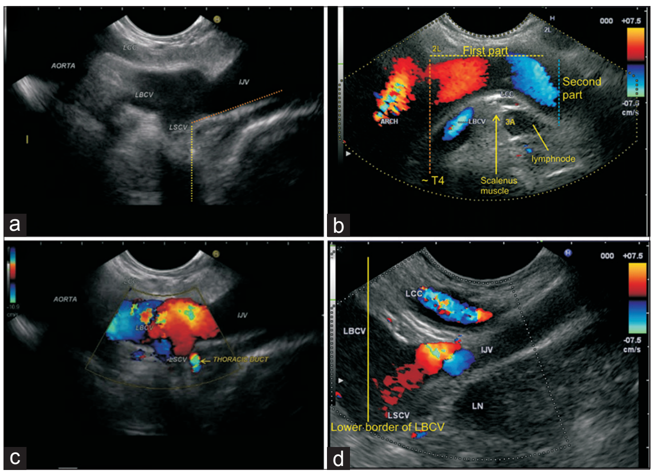

Figure 6. (a) A union of left subclavian vein and left internal jugular vein is seen. This union lies in the cervical part of mediastinum anterior to cupola. The left subclavian vein arches upward and reaches almost to the lower boundary of the supraclavicular triangle. The area above the subclavian vein can be considered as supraclavicular triangle whereas the internal jugular vein enters the carotid sheath within the carotid triangle. The orange line indicates the outer border of internal jugular vein and yellow line indicates the upper border of the left subclavian vein. (b) The left subclavian artery arises from the arch of the aorta, behind the left common carotid, at the level of the fourth thoracic vertebra (orange dotted line). The scalenus anterior muscle (yellow arrow) divides this artery into three parts. The first portion extends from the origin of the vessel to the medial border of the scalenus anterior and ascends in the superior mediastinal cavity to the root of the neck (yellow dotted line). The second portion of the subclavian artery lies behind the scalenus anterior; it is very short and forms the highest part of the arch. The second part lies behind this muscle after arching laterally (blue dotted line). The left brachiocephalic vein is seen in this image (left brachiocephalic vein) below and front of the artery and is separated from it by the scalenus anterior. The third part of subclavian artery extends from the lateral margin of the scalenus muscle to the outer border of the first rib, where it becomes the axillary artery and is not seen in this image. A lymph node belonging to Station 3a of International Association of Study of Lung Cancer classification is seen lying in the left supraclavicular triangle of neck which is the smaller and lower triangle of posterior triangle. (c) The retrotracheal space is seen in this figure, and the origin of left common carotid artery from aorta is seen. The union of the left brachiocephalic vein with left subclavian vein is also seen. The lower jugular group of the lymph node is seen. The thoracic duct is seen and the presence of color is due to partial reflux of blood into the duct at the point of union. (d) A lymph node is seen in the lowermost part of supraclavicular fossa belonging to lower jugular group, *i.e.*, Level IV (AJCC). LCC: Left common carotid; LBCV: Left brachiocephalic vein; IJV: Internal jugular vein; LSCV: Left subclavian vein; LN: Lymph node

Anterior imaging

A clockwise rotation beyond the common carotid artery takes the beam toward the anterior compartment. The visualization of structures anterior to trachea is not possible by EUS.

Identification of nodes

The important group of LNs in this place includes the lower and middle jugular group along the carotid sheath and Level VI LNs in the anterior compartment. Among the Level VI LNs, the LNs lying anterior to trachea cannot be identified, but the LNs in paratracheal region, especially on the left side can be easily identified. When the LNs are classified according to the International Association of Study of Lung Cancer, the identified subgroups are Station 2L, 2R 3a and 3p [Station 2, Figure 6d, Videos 10 and 11].

Station 3: Hypopharynx

Identification of home bases

The thyroid gland, internal jugular vein, and sternocleidomastoid muscle. It is easy to locate the common carotid artery and internal jugular vein within the carotid sheath from the hypopharynx on both sides of the neck. The thyroid cartilage creates an artifact in hypopharynx and the upper part of thyroid gland is seen on either side of thyroid cartilage closely related to common carotid artery. The sternocleidomastoid muscle is occasionally seen beyond the internal jugular vein [Station 3 and Figure 7].

Identification of anatomic landmarks

Posterior imaging

Maximum anticlockwise rotation identifies the spine posteriorly. Slight clockwise rotation identifies the longus colli muscle just adjacent to the posterior pharyngeal wall along with the vertebral artery [Station 3, Figure 8a and b].

Lateral imaging

Further clockwise rotation identifies the sternocleidomastoid muscle and the appearance of structures within the carotid sheath. The common carotid artery is very easily traced upward within the carotid sheath, and sometimes the bifurcation into external and internal carotid artery can be seen in Station 3, Figure 9a-c. The course of internal jugular vein is easily followed within the carotid sheath. Some part of the internal jugular vein is visualized through the upper part of the left or right lobe of thyroid gland.

Anterior imaging

A clockwise rotation beyond the common carotid artery takes the beam toward the anterior compartment. The visualization of structures anterior to trachea is not possible by EUS, and the visualization of pretracheal LNs is not possible. The lobes of thyroid gland and LNs on the either side of the trachea in paratracheal region (paratracheal LNs) can be visualized.

Identification of nodes

The important group of LNs in this place includes upper jugular LN station - for head and neck cancer and LNs of Station 2L, 3a and 3p for lung cancer [Station 3 and Figure 10]. No LNs are present posterior to cervical esophagus in the retropharyngeal space.

The Diagnostic US of the head and neck is mainly used to assess organs and lesions that lie near the surface, including the salivary glands, the thyroid gland, the major vessels, enlarged superficial LNs, and other superficial pathologic lesions.[19-22]

Although EUS and EUS-FNA have a well-established role in the assessment and management of gastrointestinal and pulmonary diseases, the data on their value for assessing tumors in the head and neck region are very limited.[23] Traditionally, the mediastinum and lower part of the neck has been evaluated using standard imaging techniques such as CT and MRI. Cervical LN metastases are of overriding importance in predicting the prognosis in these patients.[24] Size has been used as one of the criteria for differentiating benign from malignant LNs. LNs larger than 10 mm in size are considered abnormal but even smaller LNs may harbor metastasis.[25] CT and MRI have suboptimal sensitivity for detecting the smaller size of LNs and patients with false-negative imaging on CT or MRI are generally never referred for EUS. The decision regarding the presence of metastasis in such smaller group of LNs is of importance and EUS-FNA offers a chance to establish the presence of pathology. A comparison of ultrasound and PET/CT for staging and surveillance of head and neck and thyroid cancer found superior sensitivity (96.8% *vs.* 90.3%), specificity (93.3% *vs.* 20%),

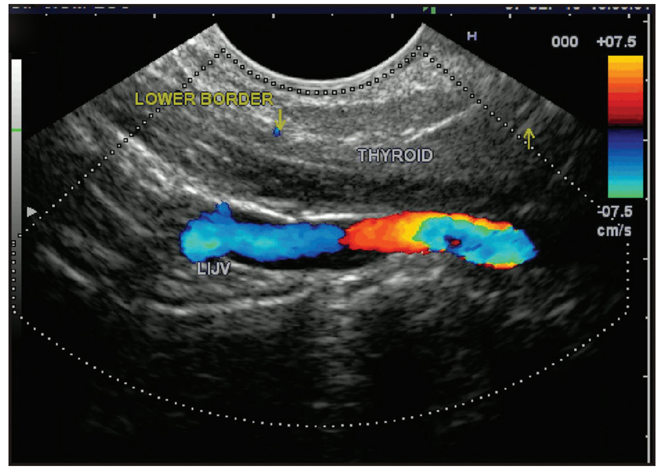

Figure 7. The thyroid gland is seen. The internal jugular vein is seen in the carotid sheath beyond the thyroid gland. With slight rotation, the common carotid artery and sternocleidomastoid muscle can be seen, however, they are not seen in this figure. LIJV: Left internal jugular vein

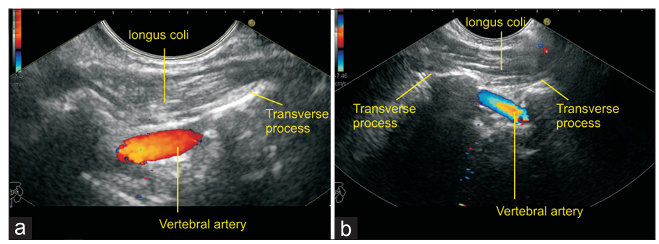

Figure 8. (a and b) The vertebral artery is seen in the areas between the two adjacent transverse processes of vertebrae. The longus colli muscle is seen between the probe and the vertebral artery. The transverse processes interrupt the visualization of the entire course of artery

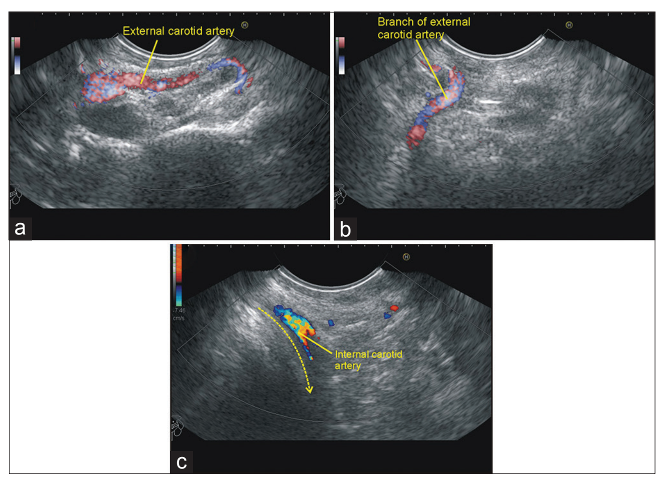

Figure 9. (a) In this case, the external carotid artery is seen with a long parallel course to the wall of pharynx. In the upper most part, the external carotid artery is seen going away from the transducer. (b) The branch of the external carotid artery is seen going away from the probe in esophagus. It can be either the superior thyroid, facial, or lingual artery. (c) The internal carotid artery is more medial and more posterior to external carotid artery and has no branch. It curves away from the pharynx and enters the base of skull

positive predictive value (96% *vs.* 70%), and negative predictive value (93% *vs.* 50%) for ultrasound compared

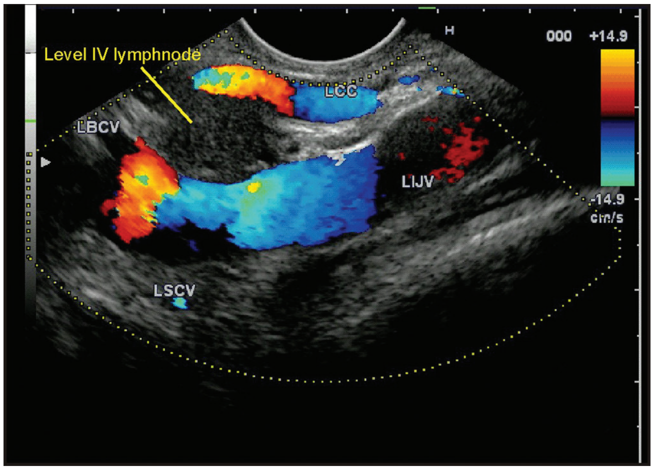

Figure 10. The carotid sheath in the neck includes the internal jugular vein and common carotid artery. In this case, two lymph nodes belonging to lower jugular station of the neck are seen within the carotid sheath posterior to the sternocleidomastoid muscle. LBCV: Left brachiocephalic vein; LCC: Left common carotid; LSCV: Left subclavian vein; LIJV: Left internal jugular vein

to PET/CT.[19] Another comparative study of ultrasound with PET/CT found that the two techniques had equivalent accuracy for surveillance of head and neck cancer, and the authors concluded that ultrasound could be considered complementary to PET/CT for detecting subclinical regional recurrences after head and neck cancer treatment.[21]

EUS and EUS-FNA do have their own limitations. For example, EUS does not allow visualization of the pretracheal and the right paratracheal region.[26] Endobronchial endosonography is helpful in patients where evaluation of the right paratracheal region is needed.[27,28] Further information is required from prospective studies comparing EUS with different imaging modalities in patients with advanced and metastatic tumors in the head and neck region.[29] The use of ultrasound as a practical tool for head and neck cancer surveillance is still relatively constrained due to the limited number of practitioners who are skilled in head and neck US. The accuracy for the staging of tumors of the neck and pickup of a smaller group of some LNs may improve if EUS is included in the imaging modalities of head and neck cancers. There is a possibility that the use of EUS and EUS-FNA will become a part of multimodality imaging during evaluation of tumors in the head and neck region.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Kraft M, Bruns N, Hügens-Penzel M, *et al*. Clinical value of endosonography in the assessment of laryngeal cancer. *Head Neck* 2013;35:195-200.
2. Kraft M, Arens C. Technique of high-frequency endolaryngeal ultrasound. *J Laryngol Otol* 2008;122:1109-11.
3. Arens C, Weigt J, Schumacher J, *et al*. Ultrasound of the larynx, hypopharynx and upper esophagus. *HNO* 2011;59:145-54.
4. Bozzato A. Interpretation of ultrasound findings in otorhinolaryngology: Skin, soft tissue of the neck, lymph nodes, and oncologic follow-up. *HNO* 2015;63:139-54.
5. Yoshino K. Classification of neck dissection. *Nihon Jibiinkoka Gakkai Kaiho* 2013;116:986-7.
6. Reimann K, Horger M, Schulze M. TMN classification of hypopharynx carcinoma – Hypopharynx carcinoma: TNM classification. *Rofo* 2013;185:1119-23.
7. Nair S, Mohan S, Nilakantan A, *et al*. Impact of (18)f-fluorodeoxyglucose positron emission tomography/computed tomography scan on initial evaluation of head and neck squamous cell carcinoma: Our experience at a tertiary care center in India. *World J Nucl Med* 2015;14:19-24.
8. Subesinghe M, Scarsbrook AF, Sourbron S, *et al*. Alterations in anatomic and functional imaging parameters with repeated FDG PET-CT and MRI during radiotherapy for head and neck cancer: A pilot study. *BMC Cancer* 2015;15:137.
9. van Zoonen M, van Oijen MG, van Leeuwen MS, *et al*. Low impact of staging EUS for determining surgical resectability in esophageal cancer. *Surg Endosc* 2012;26:2828-34.
10. Dietrich CF, Saftoiu A, Jenssen C. Real time elastography endoscopic ultrasound (RTE-EUS), a comprehensive review. *Eur J Radiol* 2014;83:405-14.
11. Sharma M, Arya CL, Somasundaram A, *et al*. Techniques of linear endobronchial ultrasound imaging. *J Bronchology Interv Pulmonol* 2010;17:177-87.
12. Sharma M, Rameshbabu CS, Mohan P. Standard techniques of imaging of IASLC borders by endoscopic ultrasound. *J Bronchology Interv Pulmonol* 2011;18:99-110.
13. Jalil AA, Elkhatib FA, Mahayni AA, *et al*. Primary papillary thyroid carcinoma diagnosed by using endoscopic ultrasound with fine needle aspiration. *Clin Endosc* 2014;47:350-2.
14. Mavrogenis G, Hassaini H, Sibille A, *et al*. Expanding the horizons of endoscopic ultrasound: Diagnosis of non-digestive pathologies. *Gastroenterol Rep (Oxf)* 2014;2:63-9.
15. Kordylewska M, Szmeja Z. Endoscopic head: The ultrasound examination of mouth, pharynx and nasopharynx. *Otolaryngol Pol* 1993;47:247-52.
16. Chen L, Cui TT, Wang G, *et al*. Intra-nasal scanning of tumors in nasal cavity and paranasal sinus with endoscopic ultrasonography. *Zhonghua Er Bi Yan Hou Tou Jing Wai Ke Za Zhi* 2007;42:23-6.
17. Wildi SM, Fickling WE, Day TA, *et al*. Endoscopic ultrasonography in the diagnosis and staging of neoplasms of the head and neck. *Endoscopy* 2004;36:624-30.
18. Riskalla A, Arora A, Vaz F, *et al*. Novel use of ultrasound-guided endo-cavitary probe to evaluate an impalpable parapharyngeal mass. *J Laryngol Otol* 2010;124:328-9.
19. Hwang HS, Perez DA, Orloff LA. Comparison of positron emission tomography/computed tomography imaging and ultrasound in staging and surveillance of head and neck and thyroid cancer. *Laryngoscope* 2009;119:1958-65.

20. Wang SJ. Surveillance radiologic imaging after treatment of oropharyngeal cancer: A review. *World J Surg Oncol* 2015;13:94.
21. Wierzbicka M, Popko M, Piskadlo K, *et al.* Comparison of positron emission tomography/computed tomography imaging and ultrasound in surveillance of head and neck cancer – The 3-year experience of the ENT department in Poznan. *Rep Pract Oncol Radiother* 2011;16:184-8.
22. Dammann F, Bootz F, Cohnen M, *et al*. Diagnostic imaging modalities in head and neck disease. *Dtsch Arztebl Int* 2014;111:417-23.
23. Steinhart H, Mendel M, Schroeder HG. Endosonography of the pharynx. *Laryngorhinootologie* 1996;75:682-6.
24. Hirabayashi H, Koshii K, Uno K, *et al.* Extracapsular spread of squamous cell carcinoma in neck lymph nodes: Prognostic factor of laryngeal cancer. *Laryngoscope* 1991;101:502-6.
25. Reid AP, Robin PE, Powell J, *et al*. Staging carcinoma: Its value in cancer of the larynx. *J Laryngol Otol* 1991;105:456-8.
26. Sharma M. Combined imaging for benign mediastinal lymphadenopathy: Endoscopic ultrasonography first or endobronchial ultrasonography first? *Chest* 2011;140:558-9.
27. Wang KP, Feller-Kopman D, Mehta A, *et al*. Endobronchial ultrasound and esophageal ultrasound: Just because we can, does not necessarily mean we should. *Chest* 2011;140:271-2.
28. Sharma M, Chittapuram RS, Rai P. Endosonography of the normal mediastinum: The experts approach. *Video J Encyclopedia GI Endosc* 2013;1:56-9.
29. Sparchez Z, Radu P, Kacso G, *et al*. Contrast-enhanced ultrasound guided biopsy of superficial toraco-abdominal and neck lesions. Initial experience in 20 patients. *Med Ultrason* 2012;14:288-93.