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EUS-B for the Interventional Pulmonologist Using the EBUS Scope in the Esophagus

Yousef R. Shweihat and Shantanu Singh

Abstract

This chapter aims at introducing the interested Pulmonologist/Interventional Pulmonologist to the esophageal ultrasound. In this chapter, we give short descriptions of some technical aspects of the endobronchial ultrasound (EBUS) scope and explain in detail why we believe the EBUS scope is well suited to be an esophageal scope in the hands of the trained pulmonologist. The chapter then explains indications and benefits of this procedure that we consider central to the practice of chest physicians. We also describe in steps how to reach each lymph node station using the EBUS scope as a EUS scope (EUS-B) from our own experience. Procedure-related complications and contraindications are also described.

Keywords: esophageal ultrasound, endobronchial ultrasound, lymph node stations

1. Introduction

Interventional pulmonary has witnessed substantial growth in the past few years. A major factor in the growth has been the advent of endobronchial ultrasound (EBUS) as a staging modality for lung cancer and as a diagnostic tool for diseases with mediastinal involvement. The development of EBUS was preceded by esophageal ultrasound (EUS), and the literatures on both techniques have grown in parallel. More recently, the efficacy and utility of an esophageal approach using the EBUS scope (EUS-B) has been described to access nodes and masses accessible during a single sedation to more accurately diagnose and stage disease either via tracheal or esophageal route. Here, we describe relevant anatomy, procedural techniques, indications, contraindications, and complications for EUS-B.

2. Technical aspects

2.1 EBUS bronchoscope

EBUS can refer to two distinct types of probes/scopes. Radial probe EBUS is the first type, and was commercially available in 1992. It increased the yield of transbronchial needle aspiration of mediastinal lymph nodes and is currently used mainly to biopsy peripheral nodules or examines the different central airways diseases. The second type is the convex/curvilinear probe EBUS bronchoscope. It was introduced in 2002 and commercialized around 2004. In this chapter, our

discussion is limited to the most widely available curvilinear scope manufactured by multiple companies (Olympus, Fuji, and Pentax) with minimal differences in characteristics. The differences between scopes are beyond the scope of this text. The reader is encouraged to be familiar with the specifications of the scopes and their relative US processors available at his/her institution. Some features are worth mentioning though which are big difference between the EBUS and conventional EUS scopes. The working tube of about 60 cm is much shorter than the EUS. The largest intubating diameter at the tip of the EBUS scopes ranges from 6.7 to 7.4 mm. The remainder of the insertion tubes has a diameter of 6.3–6.4 mm. The working channel diameter is from 2.0 to 2.2 mm. The ultrasonic transducer is situated at the tip of the bronchoscope just distal to the video camera, light source, and the working channel aperture. It emits ultrasonic waves that range from 5 to 12 MHz, and this depends on the ultrasound processor used and settings selected. The ultrasonic scanning range obtained via these scopes is triangular in shape and yields a 60–75° view parallel to the insertion tube. The tissue depth of ultrasonic views and focusing capabilities can be altered and varies according to the ultra-sound processor used. Multiple manufacturers offer single-use aspiration needles available in 19G, 21G, and 22G with excellent puncture capability under ultrasonic view. The design improves visibility on ultrasound images to enable a precise puncture. After loading and securing the needle in the working channel, the needle extends out of the channel and intersects with the ultrasonic view enabling the endoscopist to control the depth and location of needle insertion into the lymph node in a real time fashion.

2.2 Why the EBUS scope, not the EUS scope?

The EBUS scope is different in many ways from its counterpart used in the GI tract. **First**, the diameter is almost half of any available ultrasound endoscope. In our opinion, this makes the bronchoscope more comfortable for the patient, and reduces sedation requirement. **Second**, the control part of the bronchoscope has fewer controllers making it easier for the pulmonologist to handle. It is a design that they are used to and comfortable using with no need for extra training to be able to handle it. This in our opinion shortens the learning curve. **Third**, it enables the thoracic physician to completely evaluate the mediastinum in one session using one piece of equipment. This minimizes the costs of additional equipment and need for additional procedure without compromising on patient management. **Fourth**, the EBUS scope is shorter than the EUS scope, thus enhancing maneuverability. This shorter length is well suited for sampling thoracic and mediastinal structures. Sampling of the pancreas or abdominal lymph nodes is out of the scope and exper-tise of most thoracic physicians. Added length of the EUS scope does not offer additional advantage to a practicing pulmonologist.

3. Indications

One of the major advances in the treatment of lung cancer is the advent of non-surgical pathologic staging using EBUS. The combination of EBUS and EUS for sampling of mediastinal nodes allows near complete staging of the mediastinum [1–3], which is equivalent, if not superior to mediastinoscopy in experienced hands [4, 5]. Multiple studies showed the EBUS scope efficacious in serving the EUS scope role (EUS-B) [6, 7]. The added benefit of the esophageal access in staging lung can-cer comes from its ability to reach and locate lymph nodal stations that are impos-sible to reach via the airways such as stations 3p, and paraesophageal lymph nodal

Lymph node station	EBUS	EUS-B
1	+	−
2R	+	+
2L	+	+
3a	−	−
3p	−	+
4R	+	−
4L	+	+
5	−	+
6	−	*
7	+	+
8 R,L	−	+
9 R,L	−	+
10–12 R,L	+	−

reported using EUS but not EUS-B.

Table 1.
Lymph nodes accessible by EBUS vs. EUS-B.

Indications for EUS-B
Lung cancer staging, stations 3p, 8, 9, 5, and 4L and 7
Paraesophageal abnormalities not accessible via the airways
Mediastinal masses that can be approached through airway and esophagus, esophagus is preferred for patient comfort
Sampling mediastinal lymphadenopathy of any etiology
Mediastinal pathology in critically ill or intubated patients
Sampling and drainage of mediastinal cysts
Bleeding diathesis (see text)

Table 2.
Indications for EUS-B.

stations 8 and 9 (see **Table 1** for lymph node stations accessible by EBUS and EUS). Given the literature on combined EBUS and EUS, it can be argued that EBUS and EUS-B should be performed at the same time for all patients with suspected lung cancer at institutions where rapid on-site cytologic evaluation is not available. This approach is recommended by the European Society of Gastrointestinal Endoscopy (ESGE) and European Respiratory Society (ERS) guidelines [8]. The utility of EBUS and EUS-B is not limited to staging or diagnosis of lung cancer. The EBUS has well documented advantages in diagnosing mediastinal lymphoma [9–11], sarcoidosis [12–14], tuberculosis [15, 16], pulmonary parenchymal masses [17, 18], and metastatic disease to the mediastinum [19], among others including infections [9, 20]. EUS-B has the same ability to investigate the mediastinum when such conditions are suspected, since the utility of EUS is well documented in such disease states [21, 22]. In addition, instances where a mediastinal mass or lymphadenopathy is paraesophageal and paratracheal, the esophageal approach might be preferred, especially when there is difficulty to access the airway due to patient intolerance or if accessing the airway predisposes increase risk to hypoxemic, intubated, and critically ill patients [23]. The indications for EUS-B are summarized in **Table 2**.

4. Anesthesia

EBUS bronchoscopy is carried out under either conscious sedation or general anesthesia with laryngeal mask airway (LMA) or intubation. EUS/B can be performed in the same setting under general anesthesia or conscious sedation. Patient tolerance seems to be adequate when conscious sedation is used [24]. Multiple drug regimens are available for conscious sedation. We do not recommend one regimen over the other. Local expertise, hospital policies, availability of an anesthesia team, and costs govern the types of sedatives and techniques used. Institutional protocols should be developed and followed to ensure safety of procedures. Even when LMA is used, EUS-B can still be performed in the same setting as described below. This is one benefit of EUS-B over conventional EUS. It is important to mention in this setting that endotracheal intubation is not prohibitive of performing EUS-B and is actually an indication as mentioned earlier. In the intubated and/or the critically ill patient, EUS-B allows us the easiest and sometimes the only access to mediastinal pathology. It is our experience that this approach does not require more sedation than required for mechanical ventilation.

5. Insertion techniques for EUS-B

It is necessary to intubate the oral cavity (as opposed to the nares) when using the EBUS scope. A "bite block" (in cases of intubation, in ICU and conscious sedation) should be used to protect the scope from potential damage from a bite if LMA is not used. An added oropharyngeal airway, such as the Williams airway, can facilitate passage of the scope into the supraglottic/posterior pharyngeal space and offer further protection to scope under conscious sedation.

When conscious sedation or endotracheal (ET) tube is used and once in the posterior pharyngeal space, the scope can be advanced into the esophagus using two basic techniques. The first "blind" technique involves holding the scope with the ultrasound transducer facing the posterior pharynx. Patient is instructed to swallow after instillation of topical lidocaine or saline. Once the patient starts swallowing, the
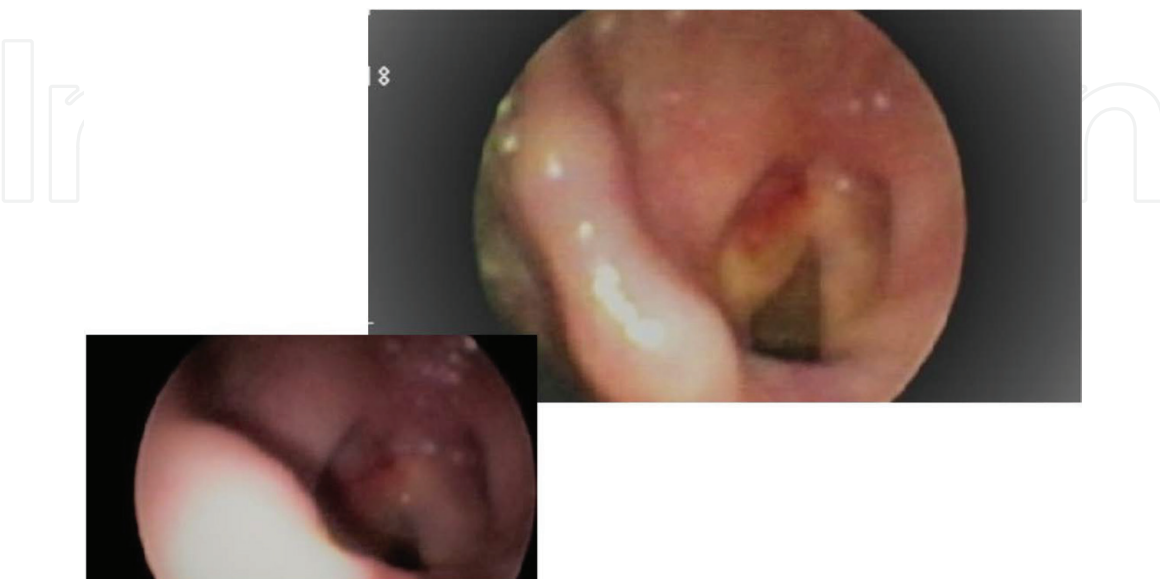
Figure 1.
After bypassing the epiglottis, to enter the esophagus, the scope needs to be placed behind the left arytenoid. Vision will cease after that point and US vision should be used to assist locating the probe position in the esophagus. Note: gentle pressure with some corkscrew or alternating mild upward and downward movements on the scope lever will assist in entering the esophagus.

scope can be advanced with gentle pressure, allowing the peristaltic wave to carry it. Rapid minor alternating flexion and release of the scope using the control lever can aid passage of the scope into the esophagus. If the blind technique fails, the scope can be passed under direct visualization. The scope can be inserted with the transducer (and visual field) facing anteriorly. Once in the posterior pharynx, the tip can be retroflexed and the larynx visualized. The tip of the scope can then be passed posterior to the arytenoids and to left with gentle pressure, see **Figure 1**. If resistance is faced, the scope can be withdrawn and another attempt on the right side or midline can be tried. It is important not to use excessive pressure if the scope does not pass easily. A gentle corkscrew maneuver with gentle advancement is all that is required.

The use of the LMA is prohibitive of using the conventional EUS scope but not the EUS-B. The LMA inherently obstructs the esophageal opening. Once the EBUS scope is at the level of the larynx, the tip is pointed and scope placed behind the left arytenoid. An assistant is asked to perform a jaw thrust maneuver that will elevate the laryngeal structures and give enough space for the small EBUS scope to be gently passed into the esophagus. Once in the esophagus, the jaw thrust can be stopped and procedure is continued. In our experience, with over 500 EUS-B procedures, we have not experienced failure or a complication passing the scope into the esophagus using any of these techniques.

6. Anatomic landmarks and organs studied

In contrast to EBUS in the airways, EUS-B relies entirely upon ultrasonic images for localization; the esophagus has no internal landmarks for nodal mapping. Because of this, lymph node stations are identified and numbered based upon their relationships with other structures "seen" ultrasonographically through esophageal wall. In addition, interpersonal variability exists between patients, and large mediastinal tumors or abnormalities can alter the normal anatomy and displace or compress the esophagus or other structures, thus altering the ultrasonic views and anatomic relations. A computerized tomographic scan is almost invariably available. It is advised that the endoscopist carefully review patient anatomy prior to and during the procedure to avoid sampling normal structures.

The mediastinal structures that can be normally seen and examined on EUS-B are:

1. Cardiac structures: left atrium, left ventricle, aortic valve, mitral valve, pericardium

2. Thoracic aorta: descending, arch, root

3. Pulmonary vessels: left pulmonary artery, right pulmonary artery

4. Vertebral bodies

5. Mediastinal pleura and pleural effusion if large enough

6. Mediastinal lymph nodes

7. Liver

During the initial training for EUS, it is important to define a point of reference that the endoscopist can refer to during the procedure. In our practice, we first identify the left atrium as a point of reference. The scope is advanced into
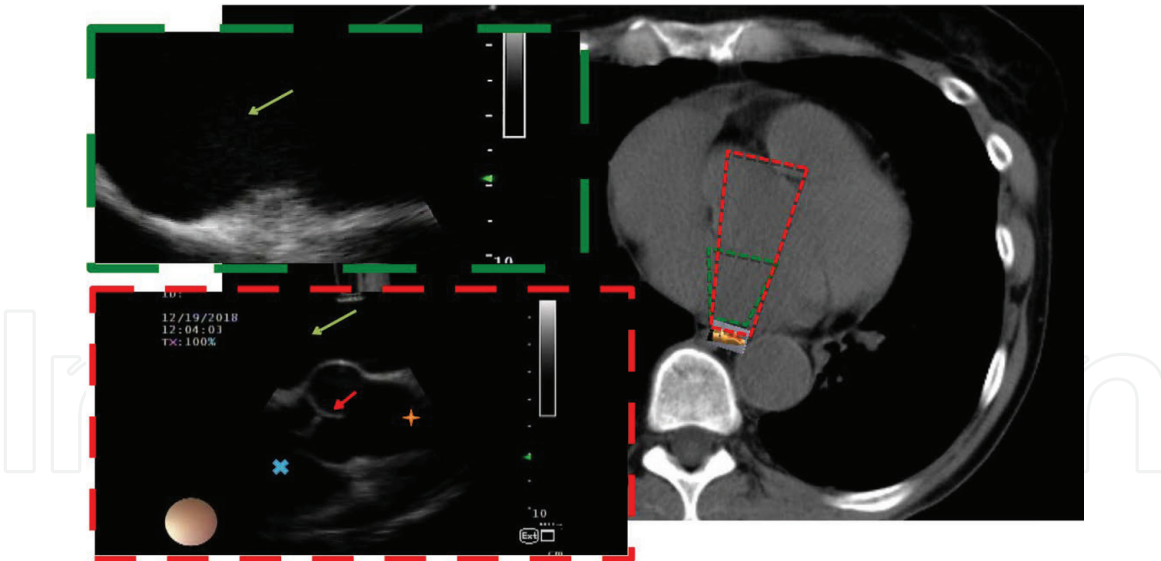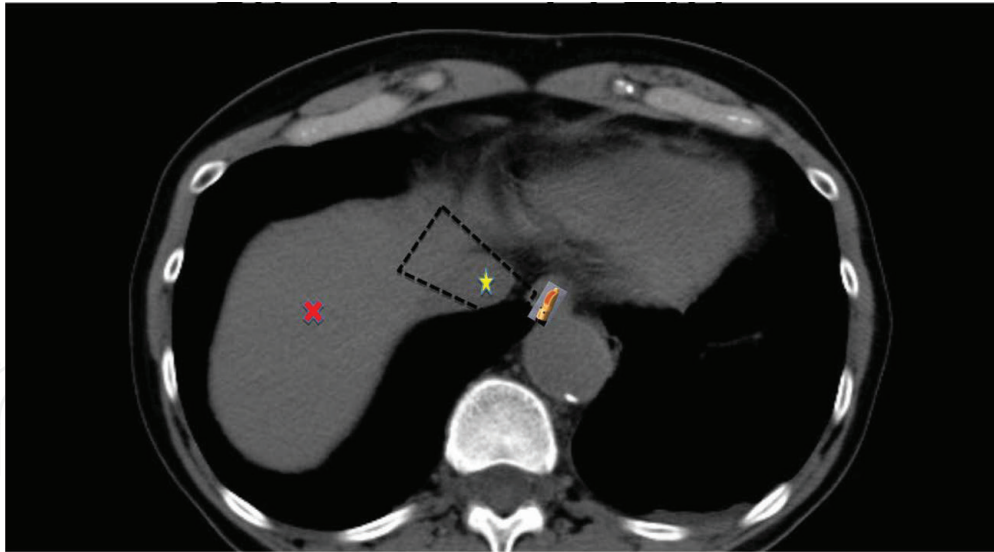
Figure 2.
At 3–4 cm depth (dashed green), the left atrium (green arrow) can be seen looking anteriorly. Increasing the depth to 5–7 cm and slight rotation can identify the aortic valve (red arrow), root (orange star), and outflow tract from left ventricle (blue x).
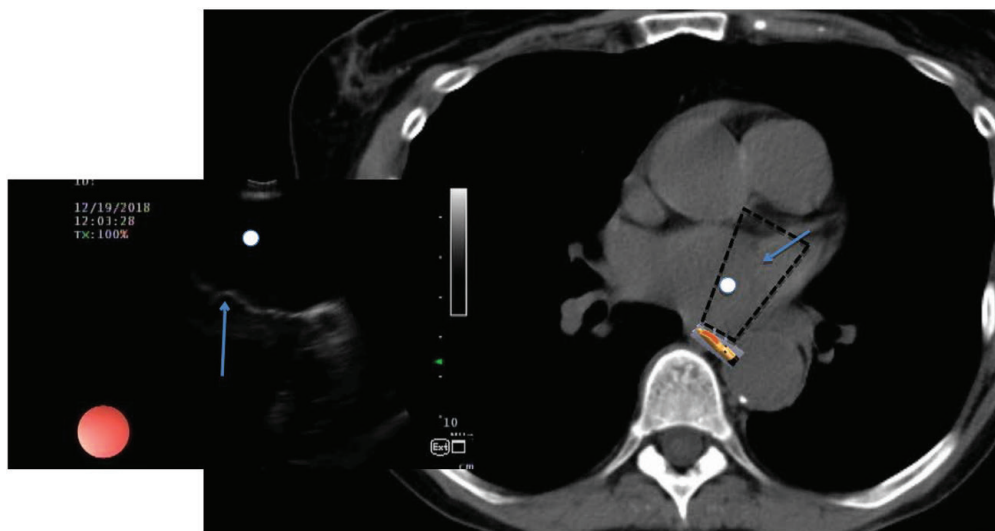
Figure 3.
Moving distally with slight rotation to left and increased depth can show the mitral valve (blue arrow) under the LA (white circle).

the esophagus with the ultrasound transducer facing anteriorly until the atrium can be identified. The atrium is easily identified due to its shape, its pulsating nature, and great variability in size (compared to the great vessels) with contractions (**Figure 2**, also see Video at https://mts.intechopen.com/download/index/process/324/authkey/bb9c02ba5640a4d21d4511e0a79f3621). A thin paper-like echogenic structure can usually be observed moving inside of this anechoic sac (of blood), this is the mitral valve (**Figure 3**, also see Video at https://mts.intechopen.com/download/index/process/324/authkey/bb9c02ba5640a4d-21d4511e0a79f3621). If the patient is in atrial fibrillation, this pulsating characteristic is lost, but the mitral valve movement can still be identified that helps localizing the atrium. In most instances, a slight rotation to the left is necessary to identify the atrium and mitral valve. The depth of field of the ultrasonic view can be altered. We usually leave it at 4 cm, but if in doubt, the depth of the ultrasonic view can be increased to 7.5 cm, and this will allow viewing the left

Figure 4.
At the lower end of the esophagus, looking to the right and anteriorly, one can identify the IVC (Yellow star) and liver (red X); the liver also can be seen anteriorly after the scope is passed distally.

ventricle and mitral valve and atrium easily. When using the increased depth on the ultrasonic view, the root of the aorta and the aortic valve are also easily identifiable (**Figure 2**, also see Video at https://mts.intechopen.com/download/index/process/324/authkey/bb9c02ba5640a4d21d4511e0a79f3621). It is necessary to mention here that slight variability exists between patients and moving the scope inferiorly and superiorly or small rotations are necessary to identify all of these structures. The pericardium is an echoic membrane that is almost always separated from the left atrium by a rim of physiologic effusion in this view (a dependent area just posterior to the left atrium in the supine position). When this effusion is big, it can create some confusion to the endoscopist. It is always important to identify the pericardium to avoid puncturing it. Rarely, a mediastinal cyst can occur in this position, which can make the views confusing. Again, increasing the depth on the US screen will help to identify cardiac versus noncardiac structures. In addition, the use of real time color Doppler will help to separate a cystic structure from a vascular structure, see **Figure 2**. The liver can also be noted and inferior vena cava can be examined too at the distal esophagus just before entering the stomach (**Figure 4**, Video at https://mts.intechopen.com/download/index/process/324/authkey/bb9c02ba5640a4d21d4511e0a79f3621).

6.1 Lymph node stations

In this section, we describe the anatomic definitions according to the eight edition of "Lung Cancer Staging Manual" [25]. We describe "how to reach" the lymph nodal stations, according to our practice. The EUS-B maneuver starts from our point of reference, i.e., the left atrium, in each of the descriptions stated below.
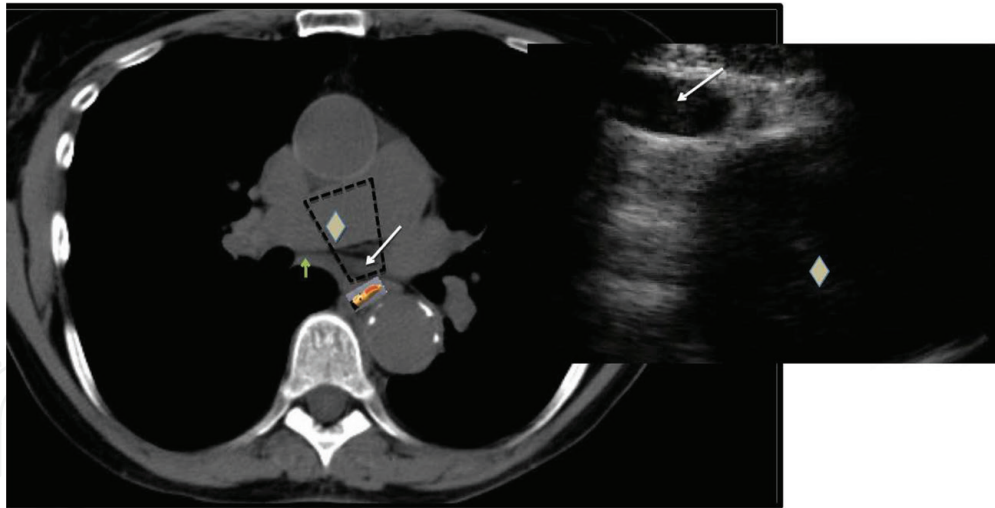
6.1.1 Station seven lymph nodes

Anatomic definition:
Mediastinal node limited by the carina superiorly and upper border of lower lobe bronchus on the left and lower border of the bronchus intermedius on the right.
Conventional name:
Subcarinal lymph nodes.

Figure 5.
*Rostrally from **Figure 2**. White arrow shows the pericardial recess, and the diamond is the right pulmonary artery crossing the mediastinum. Note: a slight rotation right will show part of station 7 LN (green arrow).*

EUS location:

This station can be located by slightly pulling the scope rostral above the level of atrium. A slight right or left rotation of the scope is necessary to choose the optimal view of the lymph node and avoid puncturing the great vessels. At the level of station seven, the right pulmonary artery can be identified crossing to the other side of the mediastinum (just deeper to the lymph node on the ultrasound screen, see **Figure 5**).

6.1.2 Stations 8 and 9

Anatomic definition:

Station 8: superiorly limited by the upper border of lower lobe bronchus on the left and lower border of the bronchus intermedius on the right and extends down to the diaphragm.

Station 9: superiorly limited by the inferior pulmonary vein and extends down to the diaphragm. These lymph nodes are located within the pulmonary ligament.

Conventional name:

8: Paraesophageal lymph nodes.

9: Pulmonary ligament lymph nodes.

EUS location:

They are identified by rotating the scope right or left with gently moving it caudally.

Station 9 is identified as any node that associated (in close proximity to) the inferior pulmonary vein and are within the pulmonary ligaments. Station 9 lymph nodes can extend in the pulmonary ligament to the diaphragm, but the only "visible" part of the station is at the junction of the inferior pulmonary vein with the left atrium.

Station 8 lymph nodes are paraesophageal lymph nodes. The upper border is difficult to localize precisely by EUS but in general are the nodes that are on either side of the esophagus below the superior border of the left atrium and extend down to the level of the diaphragm. Of note, both superior pulmonary veins and inferior pulmonary vein on the right are not always identifiable, the left inferior pulmonary vein is almost always identifiable on EUS-B and serves as a landmark for both sides of the mediastinum; it identifies the pulmonary ligament. It is hard to differentiate between level 9 and level 8 near the level of the inferior pulmonary vein. The clinical significance of this differentiation is almost nil, since the presence of metastasis to these lymph nodes from a primary lung cancer indicates N2 if on same side or N3 if the primary cancer is on the other side.

6.1.3 Station 4L

Anatomic definition:
Extends to the upper limits of the aortic arch and down to upper rim of the left main pulmonary artery.
Conventional name:
Left lower paratracheal lymph nodes.
EUS location:
This can be reached with either of two techniques. **First**, from the reference point, the scope can be rotated to the left lateral position then slowly withdrawn until the left pulmonary artery is visualized, if the scope is withdrawn more, the arch of aorta can be visualized. Station 4L is any node that is below the upper border of the arch of aorta in that view and above the upper rim of the main pulmonary artery. The **second** approach involves rotating the scope posteriorly from our reference point anticlockwise; the descending aorta can be seen as a hypoechoic elongated structure. The descending aorta can be followed upward until it starts to disappear. This is the level of the arch, which can be followed through its course at that point by rotating anteriorly (clockwise). Once the arch is identified, advancing the scope caudally will identify the station 4 lymph nodes and left pulmonary artery, see **Figure 6**.
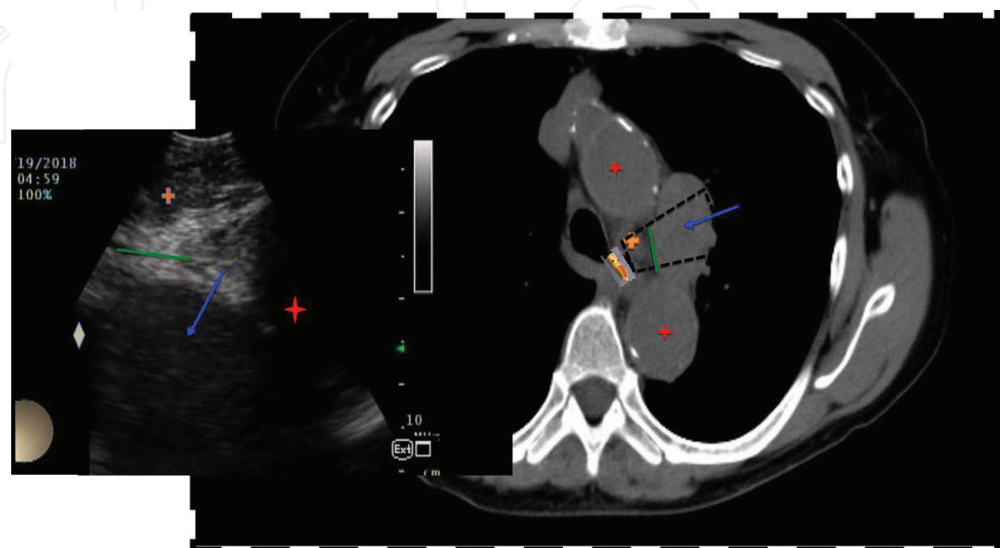
6.1.4 Station 5

Anatomic definition:
Superiorly limited by the lower border of the aortic arch and inferiorly by the upper rim of the left main pulmonary artery. Note that this station is lateral to ligamentum arteriosum, while station 4L is medial to that ligament.
Conventional name:
Subaortic (aorto-pulmonary window) lymph nodes.
EUS location:
This lymph node station can be identified using the same technique for the station 4L. The only difference is that the station 5 lymph nodes are those that are deeper to the ligamentum arteriosum and below the lower rim of the aortic arch. The ligamentum arteriosum, when visible, is identified as an elongated hyperechoic

Figure 6.
Red star is the aorta, blue arrow (mass/ LN at station 5), orange cross is station 4L, green is the ligamentum arteriosum separating 4L from station 5. Note: on US view that the ligamentum arteriosum can be seen as dense, hyper-echoic structure connecting the inferior border of aorta to the pulmonary artery.

structure connecting the left pulmonary artery to the aortic arch (**Figure 6**). It is important to mention here that sometimes, one is faced with large lymph nodes or conglomerate of nodes in this position; the differentiation between 5 and 4L can be difficult. In our opinion, both stations carry the same staging implication if positive for lung cancer (both are N2 or N3 disease, never N1) and the clinical benefit of separating the two stations becomes minimal (this issue remains controversial), see **Figure 6**.

Note: Video (https://mts.intechopen.com/download/index/process/324/authkey/bb9c02ba5640a4d21d4511e0a79f3621) shows EUS-B scope looking posteriorly from the reference point identifying the descending aorta; the scope is withdrawn rostral while following the descending aorta. Once it starts to disappear, the arch is reached. At that point, rotation clockwise to follow the arch is performed. Positioned approximately in the middle of the arch, the scope is pushed slightly caudally until the left pulmonary artery is identified. Station 4L and station 5 are between the arch and the pulmonary artery. The former is closer to the probe and the latter is beyond the echogenic ligamentum arteriosum.

6.1.5 Station 2

Anatomic definition:
Superiorly, it is limited by apex of lungs and pleural cavity and upper border of the manubrium on both sides. Station 2R is limited inferiorly by Intersection of caudal margin of the innominate vein and trachea, while on the left (2L) is inferiorly limited by the upper border of the aorta.

Conventional name:
Upper paratracheal.

EUS location:
The 2L station are identified by same maneuvers as station 4L, once the aortic arch is identified, withdrawing the scope to above the aortic arch identifies station 2L location, this station extends all the way up to the level of the manubrium anteriorly and the apex of the lung, both are hard to identify ultrasonographically. Station 2R is slightly different. Station 2R is the lymph node station that is above the level of the brachiocephalic vein and trachea intersection. Once the aortic arch is identified, close attention needs to be paid to the vessels sprouting from it, the most anterior one is the right brachiocephalic artery, this can be followed anteriorly and once sight is lost, it is crossing the trachea. At that point, rotation to the right can be done; station 2R lymph nodes are above that point. It should be noted that this is not an accurate localization (since we cannot identify the BC vein), but it is the best approximation that we could attain.

6.1.6 Station 3p

Anatomic definition:
Limited superiorly by the apex of the lungs and extends inferiorly to the level of the carina.

Conventional name:
Retrotracheal.

EUS location:
From the reference point, one can withdraw the scope until right above the level of station 7. The scope is then turned posteriorly. All posterior lymph nodes (mostly with a slight rotation to the right) are considered 3p up to the upper esophagus.
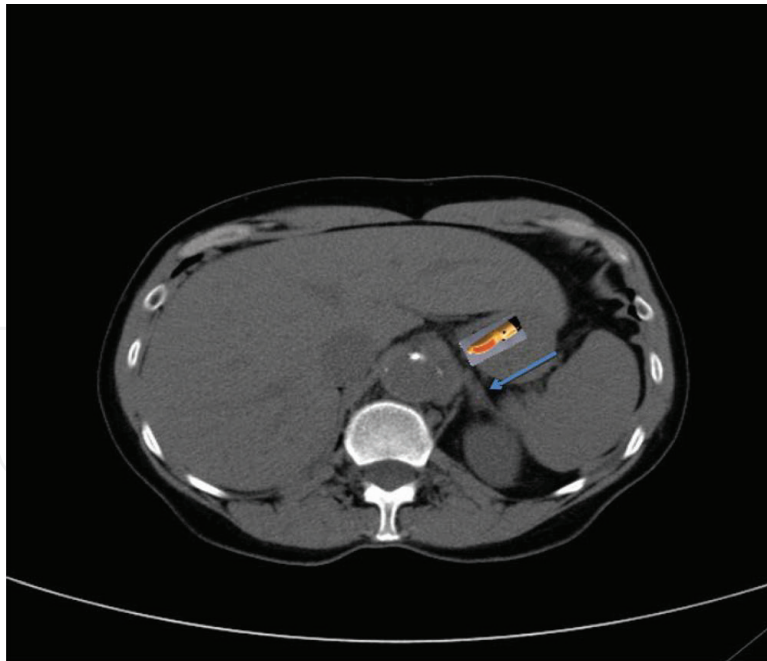
Figure 7.
Once in the stomach, looking posteriorly, one can identify the left adrenal gland (arrow).

6.2 Adrenal glands

Anatomic definition:

The adrenal glands represent the fourth most common site of metastasis for lung cancer. Identifying left adrenal gland is easier than the right. The right adrenal gland cannot be reached by EUS-B. The left adrenal gland is the more common site of adrenal metastasis and easily accessible from the stomach. The endoscopist can identify his presence in the stomach from identification of the stomach folds under US guidance and by visualization of the walls. Several reports of successful biopsy of the left adrenal gland have been described [26, 27], **Figure** 7.

7. Complications

Most of the data available here comes from the literature studying regular endoscopic devices. Endoscopy has proven to be a safe procedure. The rates of complications are probably comparable to that of bronchoscopy. These complications can be classified into two main categories.

7.1 Conscious sedation/anesthesia related

Oxygen desaturation (defined as 4% decrease in hemoglobin saturation below the baseline) can occur in up to 70% of cases without oxygen supplementation [28]. Desaturations occur in both sedated and non-sedated patients. Sedation significantly increases the risk of hypoxia [29]. Supplementary oxygen via nasal cannula reduces the risk [29, 30]. Difficult intubation, therapeutic procedures, increasing age of the patient, and concurrent pulmonary diseases all increase the risk of these events [31, 32]. It is not known if mild desaturations (a drop of 4% on the pulse oximeter) are clinically significant or not. Severe desaturations (pulse oximetry <90%) are less common and can be abolished by the use of supplemental oxygen [28, 32, 33]. The ASGE recommends the use of continuous monitoring devices (pulse oximetry) to monitor for desaturations and correction of hypoxia.

Cardiac complications during endoscopy are also commonly seen and range from mild arrhythmias to severe hypotension and cardiac arrest. Tachycardia is probably the most common arrhythmia seen [28]. A vasovagal response or discomfort from insertion of the scope can be the cause of such a response. Hypotension related to the sedation can also be seen. This can also result from the vasovagal response due to gas insufflation (which is not used during EUS-B).

7.2 Procedure related

Procedure-related complications of esophagoscopy are rare. The major complications of diagnostic esophagoscopy include bleeding, perforation, and infection [28]. Rarely, it would cause strictures or ulcerations. Most of the available literature for EUS-B is from studies evaluating EUS and EUS-FNA of the upper GI tract. Very few studies using EUS-FNA for purpose of lung cancer staging are available. These generally do not comment on rate or types of complications.

Infections can be related to inadequate equipment disinfection, which can be avoided by following the manufacturer guidelines. Another form of infection is the introduction of bacteria to the blood stream or a sterile space (the mediastinum in case of EUS/B-FNA). Episodes of transient bacteremia are a well-known occurrence after upper GI endoscopy (up to 8% of patients) [34]. This is similar for EUS and EUS-FNA according to few reports [35]. Most of these episodes of bacteremia are transient and asymptomatic. Infectious endocarditis is extremely rare (1–5×10^{-6}). Prophylactic antibiotics are not necessary for EUS-FNA, unless a cystic mediastinal structure is being sampled [34]. Febrile episodes after endoscopy are also common (about 1%) and are usually transient. Retropharyngeal abscesses have been reported after conventional endoscopy. Isolated reports of benign mediastinal cyst infection have been reported to follow EUS-FNA of these structures [36–38]. The risk for these infections seems to be very small, but one should be aware of the possibility [34]. The ASGE recommends prophylactic antibiotics at time of aspiration and for 3 days.

Perforation of the esophagus with EUS is a known but rare complication (0.03%). Most of the reported data is on radial ultrasonic probes, and limited data exist on the curvilinear probes. It seems that esophageal cancer, stricture, increased age of patient, and an operator with <1 year experience are independent risk factors for perforation [34].

Bleeding occurring can be intra-luminal or extra-luminal. While mild intra-luminal bleeds after EUS-FNA is a relatively common and expected occurrence (up to 4% in one report); extra-luminal bleeding is relatively rare or under-reported due to difficulty in diagnosis [34, 39]. The only reported cases of mediastinal bleeding for sampling of lymph nodes for cancer staging was after a transaortic approach to periaortic lymph nodes (station 6) [40].

8. Contraindications

As for any other technology or procedure, common sense should prevail. If the benefits of the procedure outweigh the risk, then the procedure is probably indicated. We feel that, when present, certain diseases should be avoided and probably considered as contraindications. Esophageal stricture greatly increases the risk of perforation especially that the EUS-B is inserted and maneuvered blindly inside the esophagus. A recent report suggests that the use of EUS-B in the presence of esophageal stricture might be safe. The smaller diameter of the scope enabled the operators to bypass the stricture and attain diagnostic materials in the cases

examined [41]. Esophageal varices and portal hypertension should also be considered a contraindication due to the increased risk of bleeding from trauma to the varices. Coagulopathy needs to be corrected and active GI bleeding is a contraindication to this procedure. We believe this procedure should only be performed where back up GI or general surgery expertise is available, in case a complication arises.

9. Summary

In this review, we have tried to lay out an overview of EUS-B. EUS-B is a natural sequel to EBUS for the interventional pulmonologist diagnosing thoracic disease. EUS/B offers access to some nodes not accessible to EBUS, and to paraesophageal masses, which are not also paratracheal. The esophagus is not housed in cartilaginous rings and structures, a factor, which may make some high thoracic lesions accessible to EUS-B alone. As with EBUS, FNA via the esophagus has an extremely low rate of complications. EUS-B does not directly impair respiration. In some cases, EBUS and EUS-B are appropriately performed concurrently, affecting an economy of time, expense, and sedation risks. In short, EUS-B is complementary to EBUS and should be integrated into the diagnostic armamentarium of interventional pulmonology.

Conflict of interest

The authors do not have any conflict of interest to disclose.

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