UNIVERSITA' DEGLI STUDI DI PERUGIA
AZIENDA OSPEDALIERA DI PERUGIA
CLINICA DI GASTROENTEROLOGIA ED EPATOLOGIA

Stemma dell'Ospedale di S. Maria della Misericordia di Perugia

Come orientarsi, cosa riconoscere: l'anatomia normale in ecoendoscopia

Perugia, 2-3 febbraio 2023

«LINEARE - COSA SI VEDE DALL'ESOFAGO»

aigo
Associazione Italiana Gastroenterologi & Endoscopisti Digestivi Ospedalieri

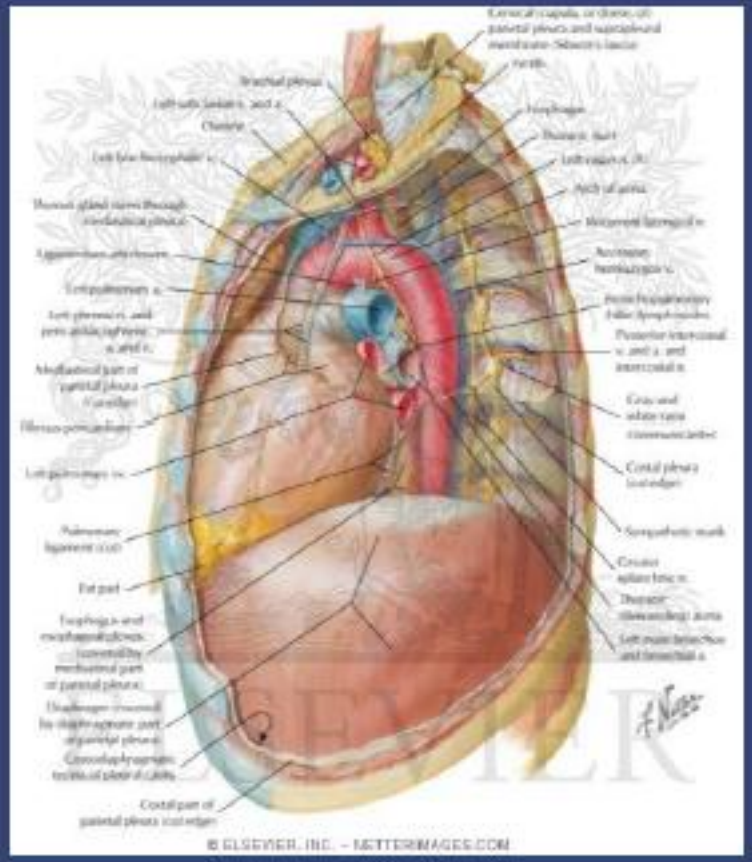
EUS aigo Academy

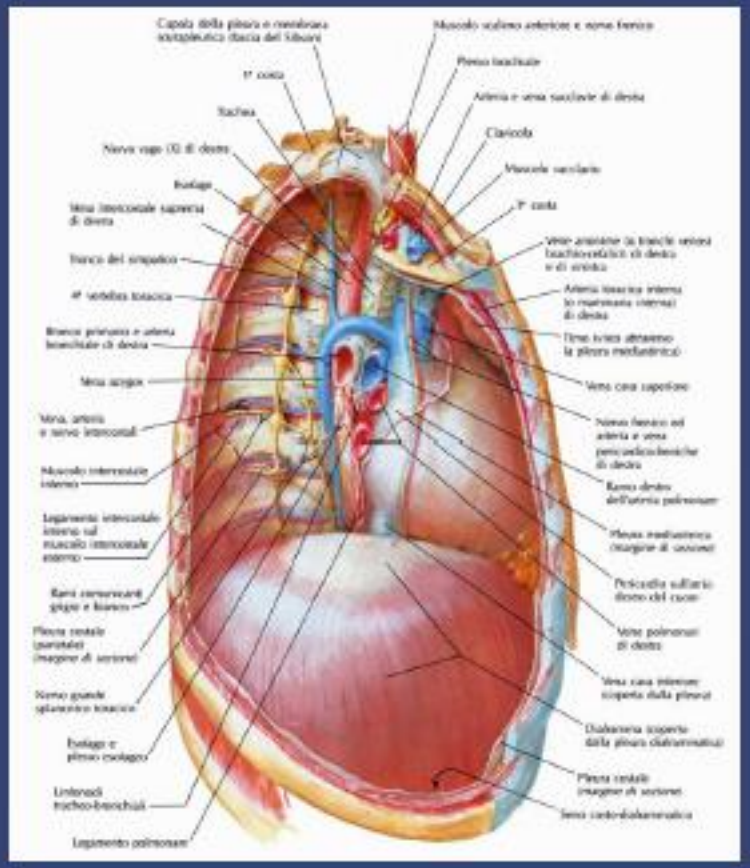
Danilo Castellani

MEDIASTINUM

ANATOMY

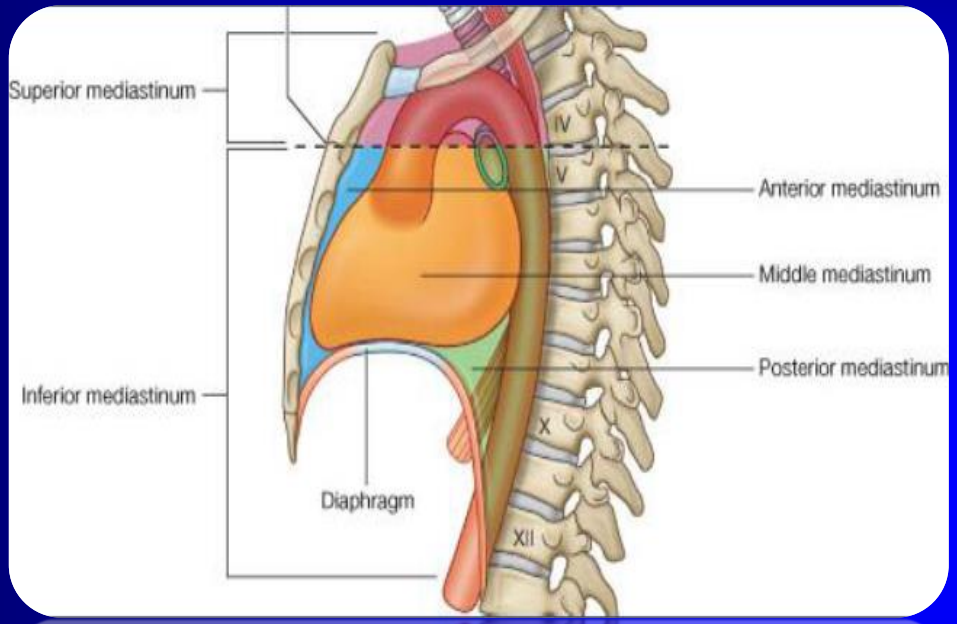
- Central compartment of the thoracic cavity
- Contains the heart and its vessels, esophagus, trachea, phrenic and cardiac nerves, thoracic duct, thymus and lymphnodes

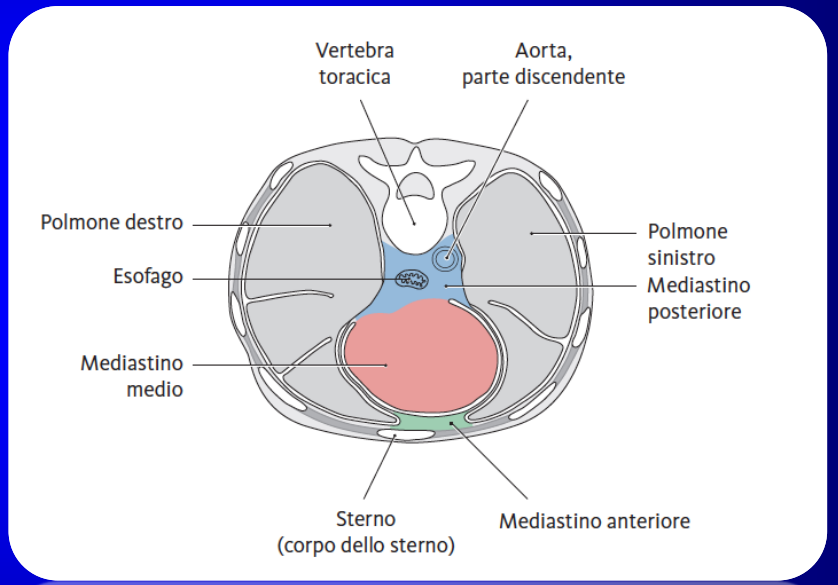


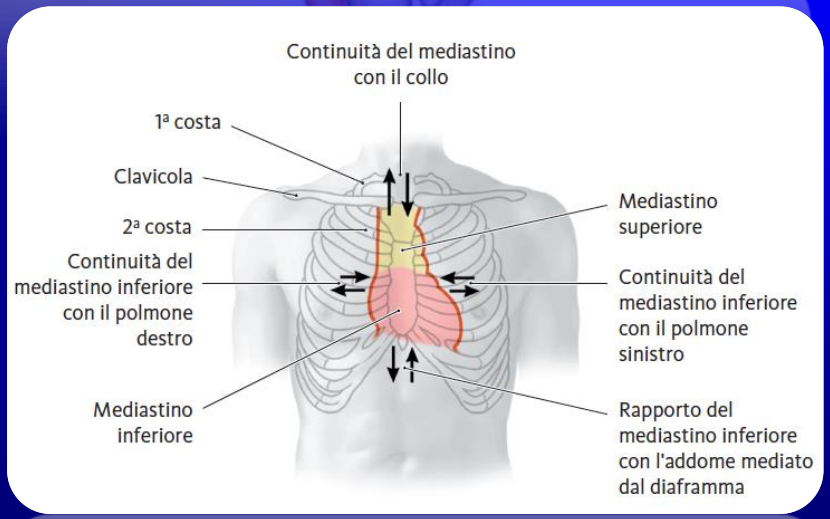


MEDIASTINUM

ANATOMY







MEDIASTINUM

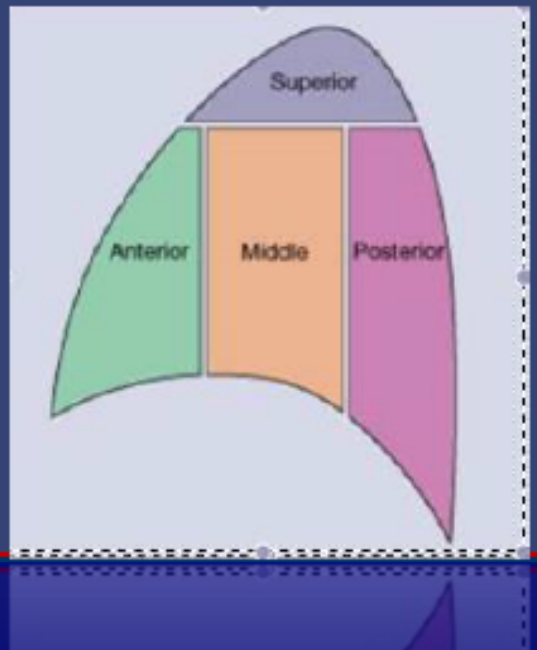
ANATOMY

- **Superior mediastinum:** from superior thoracic aperture to thoracic plane (at level of sternal angle and T4-T5).

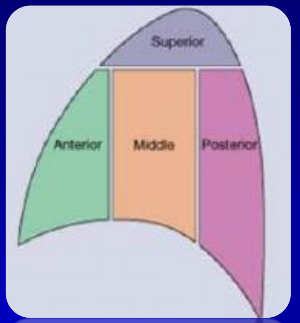
- **Inferior mediastinum:** from thoracic plane to diaphragm.

Divided in 3 parts, all relative to the pericardium:

- Anterior
- Middle
- Posterior



MEDIASTINUM
ANATOMY

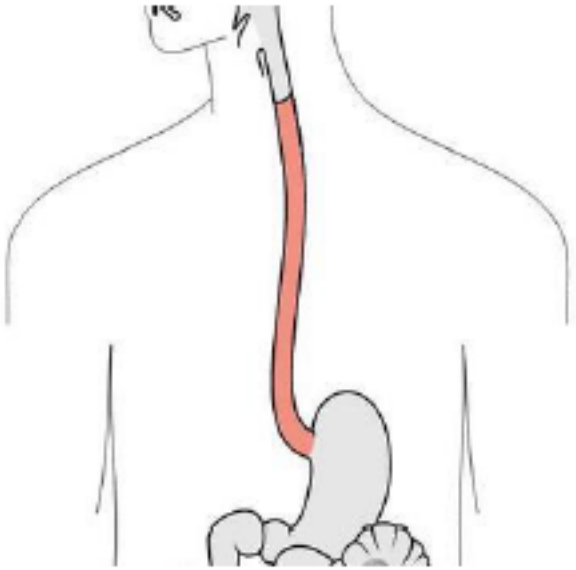


	Mediastino superiore	Mediastino inferiore		
		Mediastino anteriore	*Mediastino medio*	*Mediastino posteriore*
Organi	• Timo • Trachea • Esofago • Dotto toracico	• Timo (nei bambini)	• Cuore • Pericardio	• Esofago
Arterie	• Arco aortico • Tronco brachiocefalico • A. carotide comune sinistra • A. succlavia sinistra	• Vasi sanguigni di minor calibro	• Aorta ascendente • Tronco polmonare e sue ramificazioni • Aa. e vv. pericardicofreniche	• Aorta toracica e rami
Vene e vasi linfatici	• V. cava superiore • Vv. brachiocefaliche	• Vasi sanguigni di minor calibro e piccoli vasi linfatici • Piccoli linfonodi	• V. cava superiore • V. azigos • Vv. polmonari • Aa. e vv. pericardicofreniche	• V. azigos • V. emiazigos • Dotto toracico
Nervi	• Nn. vaghi • N. laringeo ricorrente sinistro • Nn. cardiaci • Nn. frenici	—	• Nn. frenici	• Nn. vaghi

MEDIASTINUM

EUS: PROBE

Endoscopic
Ultra**S**onography



-Radial probe

-Linear probe→ FNA (22-19G)

- Mediastinum EUS is an important modality of imaging for chest diseases

Radial

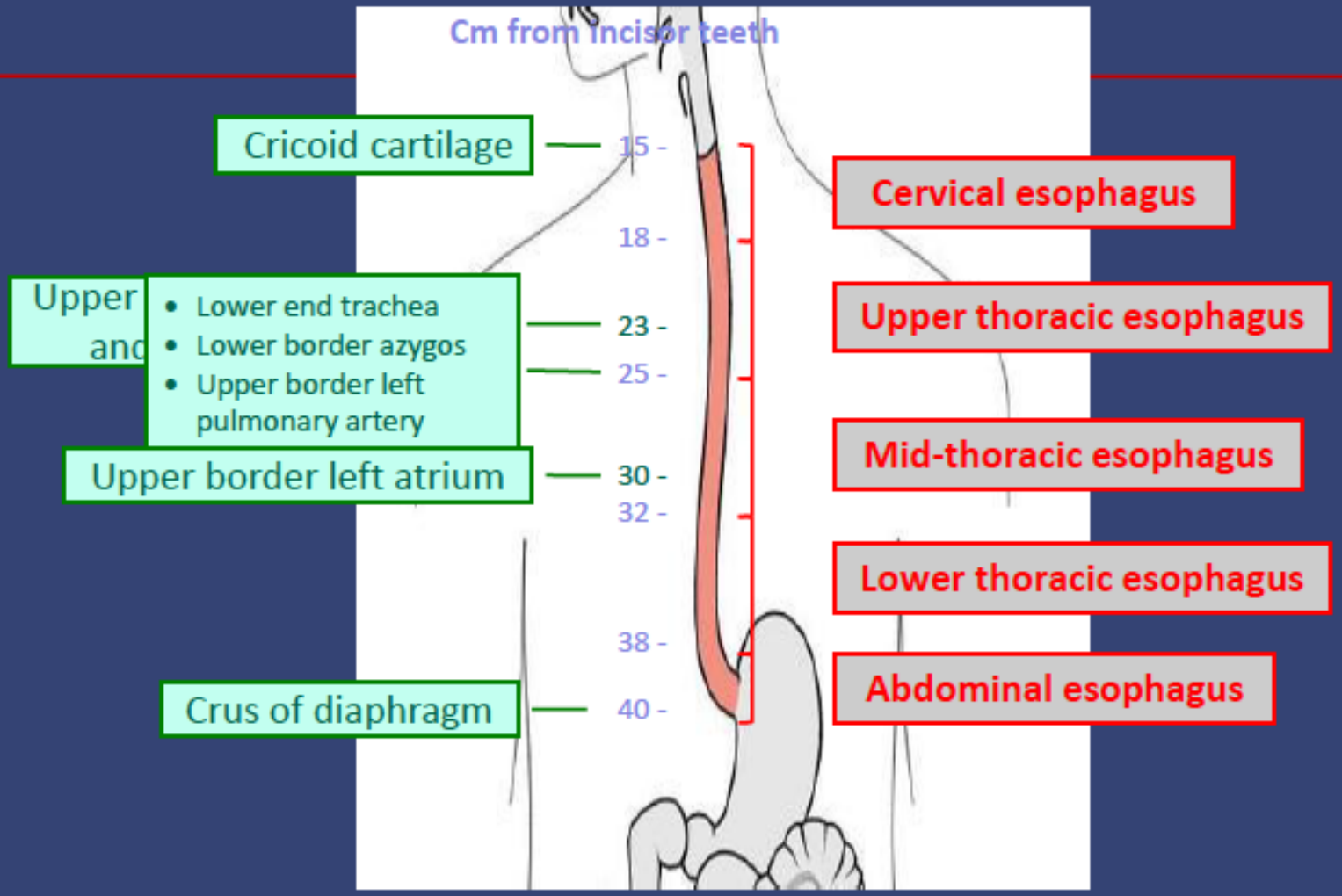


Linear



MEDIASTINUM

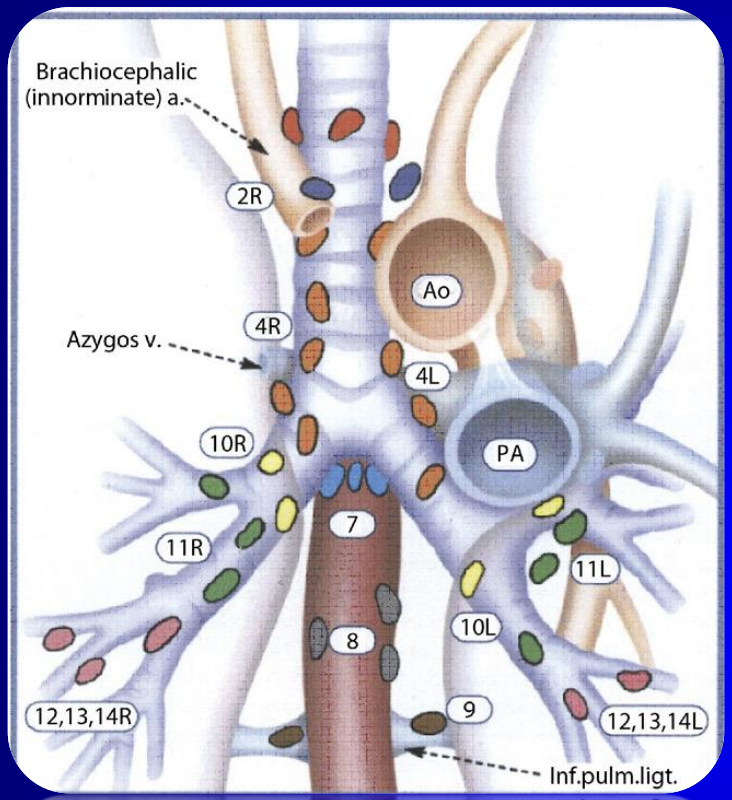
Cm from incisor teeth



Sharma et al, 2013

MEDIASTINUM

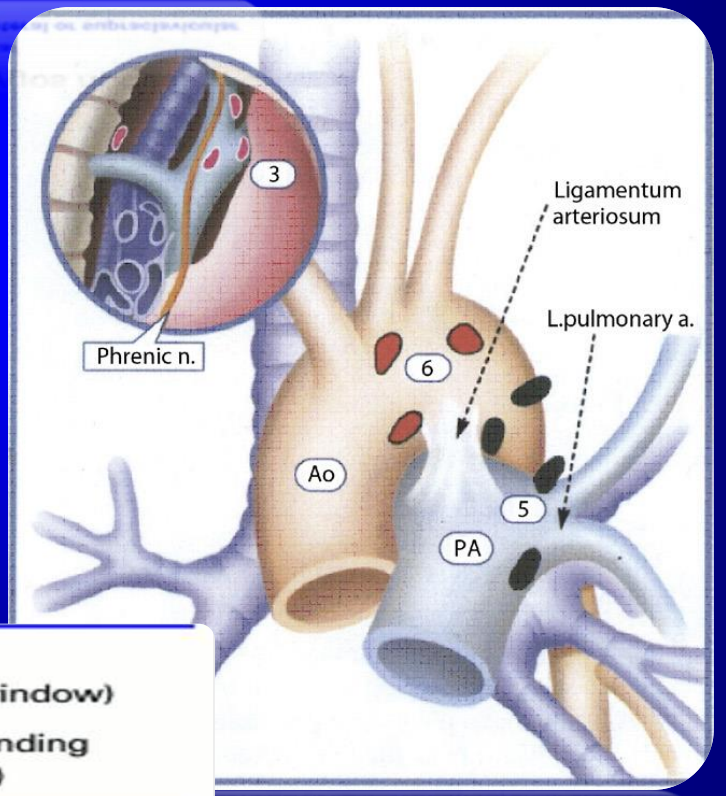
Lymph nodes



Superior mediastinal nodes

- 1 Highest mediastinal
- 2 Upper paratracheal
- 3 Prevascular and retrotracheal
- 4 Lower paratracheal (including azygos nodes)

N2 = single digit, ipsilateral
N3 = single digit, contralateral or supraclavicular



N1 nodes

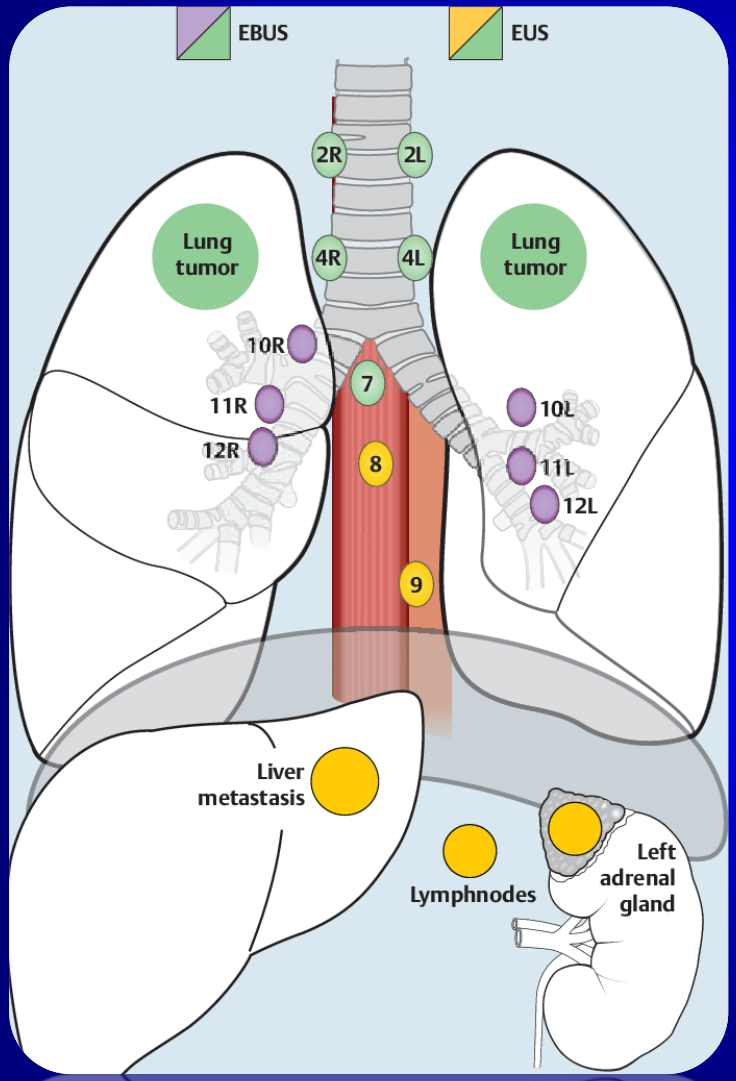
- 10 Hilar
- 11 Interlobar
- 12 Lobar
- 13 Segmental
- 14 Subsegmental

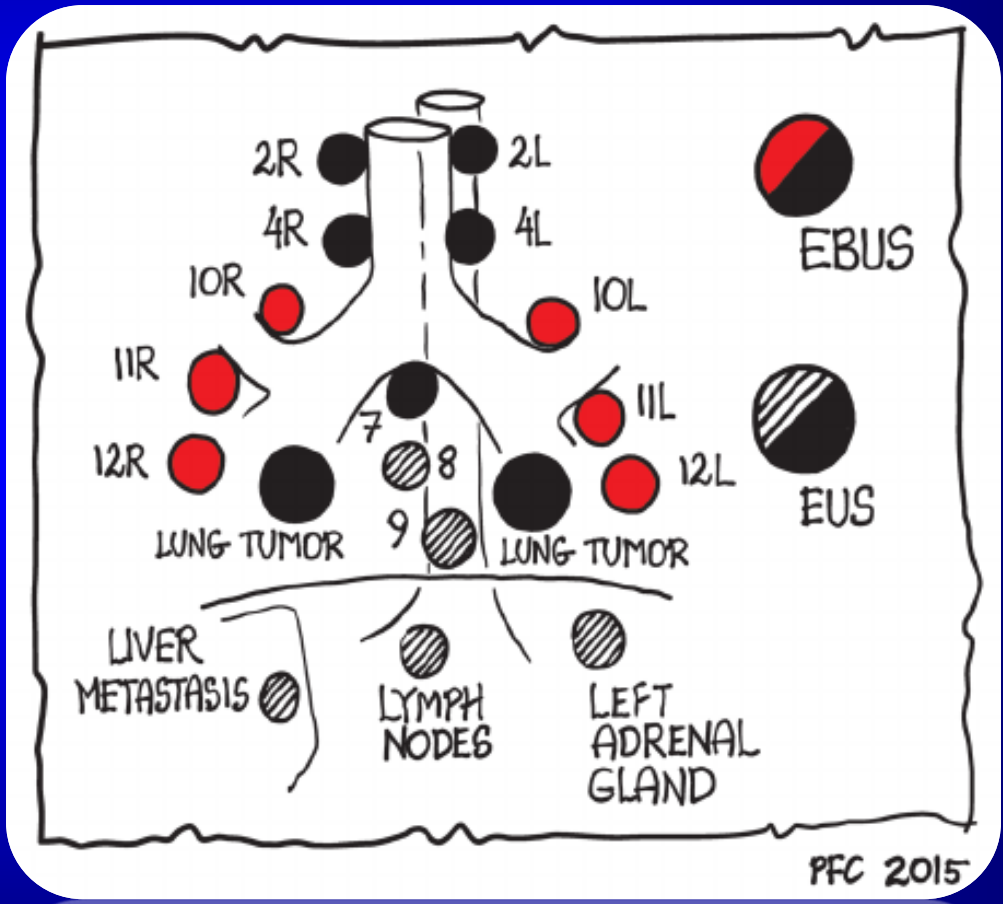
Aortic nodes

- 5 Subaortic (A-P window)
- 6 Para-aortic (ascending aorta or phrenic)

MEDIASTINUM

Lymph nodes: EUS *vs* EBUS





MEDIASTINUM

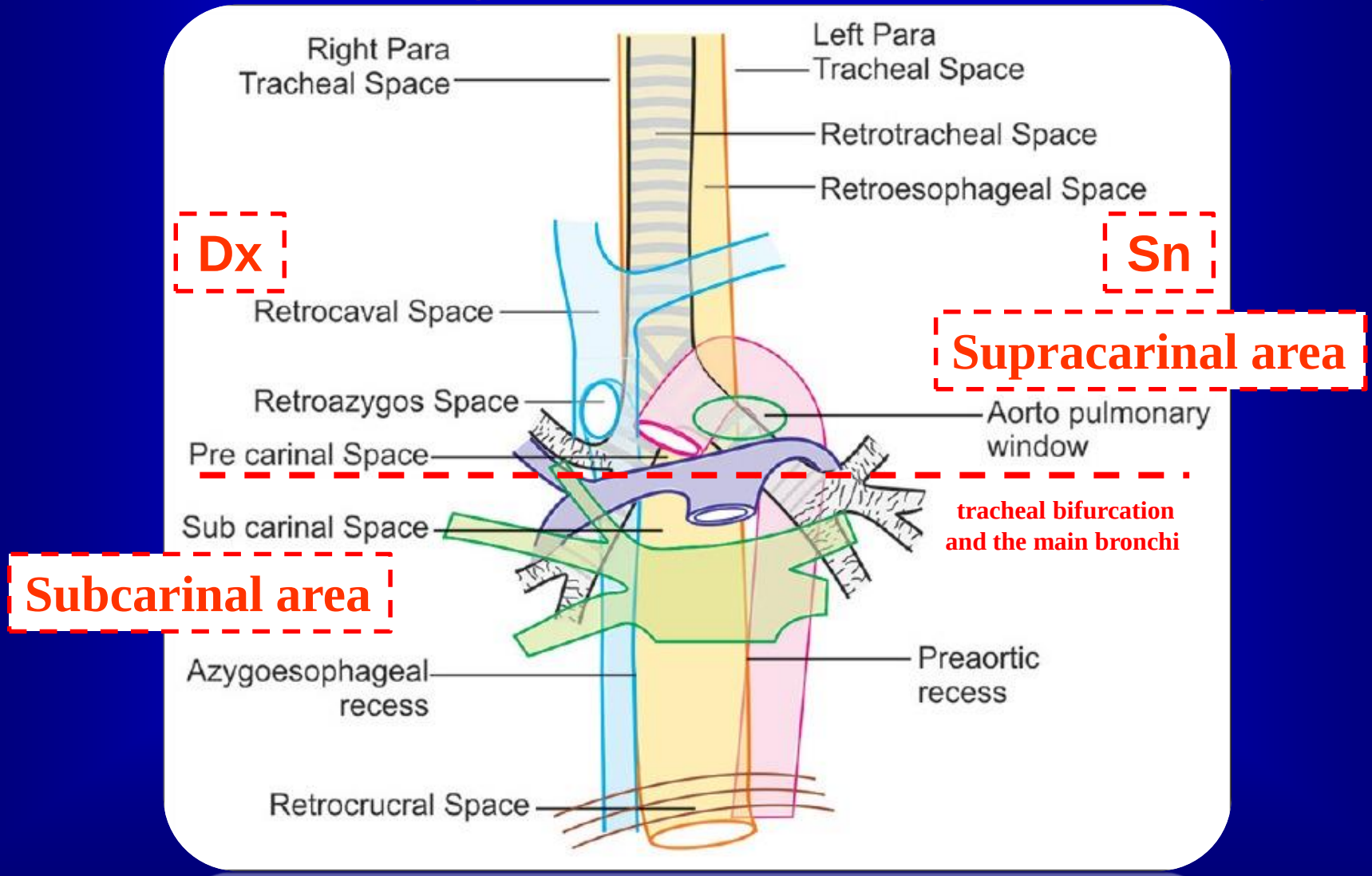
Applied anatomy of spaces of mediastinum

- The esophagus is divided into the cervical and thoracic portions.
- The cervical esophagus ends at the thoracic inlet.
- The rest of the esophagus is divided into three regions:
  1. upper thoracic portion extends from the thoracic inlet to the carina,
  2. midthoracic portion extends from the carina to esophageal hiatus of the diaphragm,
  3. lower esophagus includes the intraabdominal esophagus and the gastroesophageal junction.
- The heart and major vessels divide the mediastinum into central and anterior zones.
- CT images obtained after pneumomediastinography have also demonstrated several compartments of the mediastinum where spread of gas occurs from one space to another

MEDIASTINUM

Applied anatomy of spaces of mediastinum

A coronal view of spaces around trachea and esophagus



MEDIASTINAL SPACES

Spaces Anterior, lateral and posterior to trachea

Space	Boundaries	Contents	Communication
Spaces anterior to trachea			
Prevascular space	S: Thoracic inlet I: Diaphragm A: Sternum, anterior ends of clavicle and ribs. P: Great vessels and Heart; (i) Upper level-RBCV, LBCV; (ii) Mid-level-anterior surface of SVC, Ascending aorta; (iii) Lower level-anterior surface of heart and pericardium Lat: Mediastinal pleura at mid-level	Thymus L.N: IASLC station 3a	S: Visceral space of neck. L: Paratracheal spaces
Pretracheal space-subdivided into (i) retroinnominate, (ii) retrocaval space	S: Thoracic inlet I: Carina P: Anterior surface of trachea, carina Right A: SVC and RBCV anteriorly. Left A: Ascending aorta and enveloping superior pericardial recess	L.N: IASLC station — 2R, 4R and 2L	S: Visceral space of neck. Right: Right paratracheal space Left: Left paratracheal space Aortopulmonary window, Subcarinal space
(i) Retro-innominate space	P: Anterior surface of trachea; A: RBCV and LBCV Right: Mediastinal pleura	Brachiocephalic trunk L.N: IASLC station —2R, 2L	S: Visceral space of neck. I: Retrocaval space L: Paratracheal spaces
(ii) Retrocaval space	P: Anterior convexity of trachea A: Posterior surface of SVC and ascending aorta Left: Medial wall of aortic arch Right: Medial wall of arch of azygos vein	L.N: IASLC station 4R	S: Retro-innominate space. Right: Right paratracheal space; Left: Aortopulmonary window
Spaces lateral to trachea			
Right paratracheal space	S: Thoracic inlet I: Right tracheobronchial angle M: Right aspect of trachea; L: Mediastinal pleura related to RBCV and SVC up to arch of azygos P: Vertebrae	L.N: IASLC station — 2R and 4R. Right Brachiocephalic vein enters this space.	Pretracheal space
Left paratracheal space	S: Thoracic inlet I: Left tracheobronchial angle, intrapericardial part of left pulmonary artery M: Trachea, esophagus L: Mediastinal pleura from inlet to aortic arch level	L.N: IASLC station — 2L	Pretracheal space and aortopulmonary window
Aorto-pulmonary window	A: Ascending aorta P: Descending aorta M: Left main bronchus L: Mediastinal pleura covering upper lobe of left lung; S: Concavity of arch of aorta I : Left pulmonary artery	Ligamentum arteriosum; L.N: IASLC Station — 4L, 5 and 6	Right and left paratracheal spaces and subcarinal space
Spaces posterior to trachea			
Retro-tracheal space (raider's triangle)	S: Thoracic inlet I: Aortic arch A: Posterior aspect of trachea P: Vertebra	Esophagus Thoracic duct L.N: IASLC station — 3p	S-posterior part of visceral space of neck, I-subcarinal space Azygoesophageal recess
Retrocrural space (at aortic hiatus)	A: Crura of diaphragm and median arcuate ligament P: T-12 vertebra	Descending Aorta, Thoracic duct, Azygos vein Hemiazygos vein L.N: IASLC station 8	Communicates posterior mediastinum with retroperitoneum of upper abdomen

RBCV: Right Brachiocephalic vein, LBCV: Left Brachiocephalic vein, SVC: Superior vena cava, IASLC: International Association of Study of Lung Cancer

MEDIASTINAL SPACES

Spaces below trachea

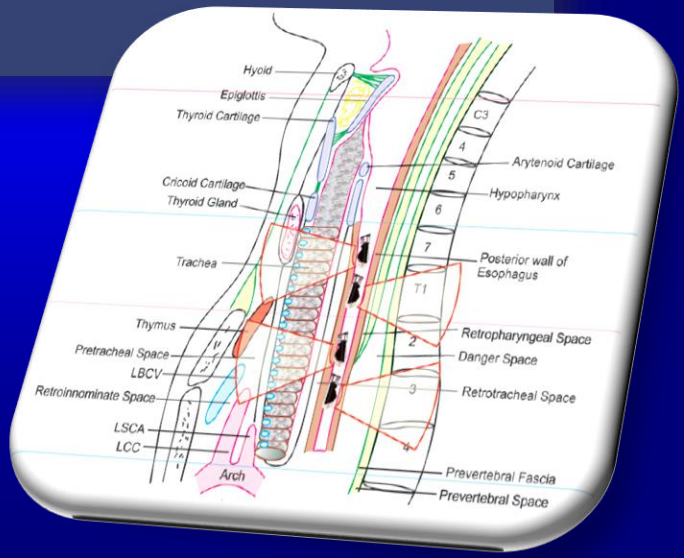
Pre-carinal	S: Pre-tracheal space I: Sub-carinal space, Left pulmonary artery on the left and truncus anterior of right pulmonary artery on the right Left: Left pulmonary artery A: Ascending aorta P: Carina	L.N: IASLC station — 7, sometimes station 10R	I : Subcarinal space
Subcarinal space*	S: Tracheal bifurcation and main bronchi I: Top of left atrium A: Intrapericardial part of pulmonary arteries and veins and Posterior wall of heart; P: Esophagus Right: Azygos vein and posterior mediastinal pleura Left : Descending aorta and posterior mediastinal pleura	L.N: IASLC station — 7	S: Aortopulmonary window and retro-tracheal spaces I: Azygo-esophageal recess on the right side
Azygo-esophageal recess (space of holzknecht)	S: Subcarinal space I: Right hemidiaphragm Anteromedial: Esophagus, Azygos vein, Left atrium P: Vertebral column	Fat Azygos vein L.N: IASLC station — 8	S: Subcarinal space I: Retrocrural space
Preaortic recess (inconstant space)	S: Sub carinal space I: Diaphragm, may end higher up also as aorta courses towards mid-line. A: Esophagus and left lung P: Vertebrae and descending aorta	L.N: IASLC station —8	S: Subcarinal space I: Retrocrural space

*Subcarinal space and Subcarinal compartments are often confused with each other. Subcarinal compartment includes subcarinal and precarinal space

MEDIASTINAL SPACES

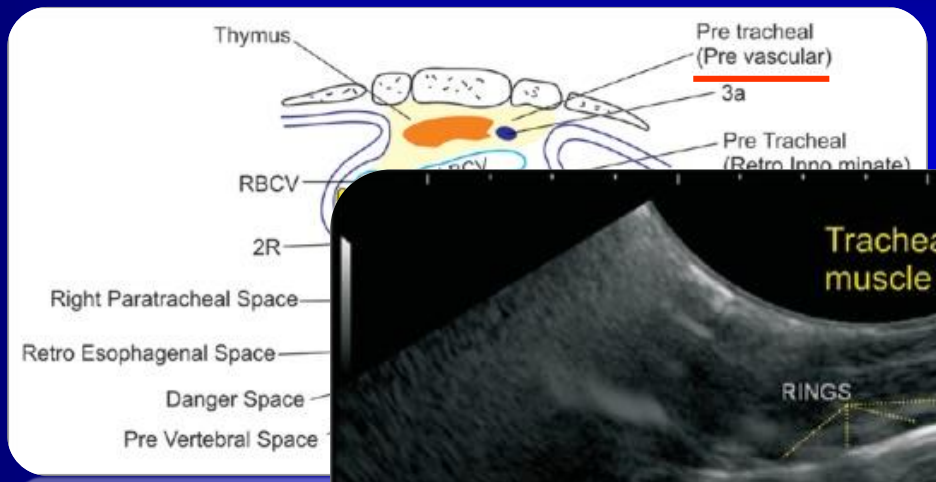
EUS linear approch

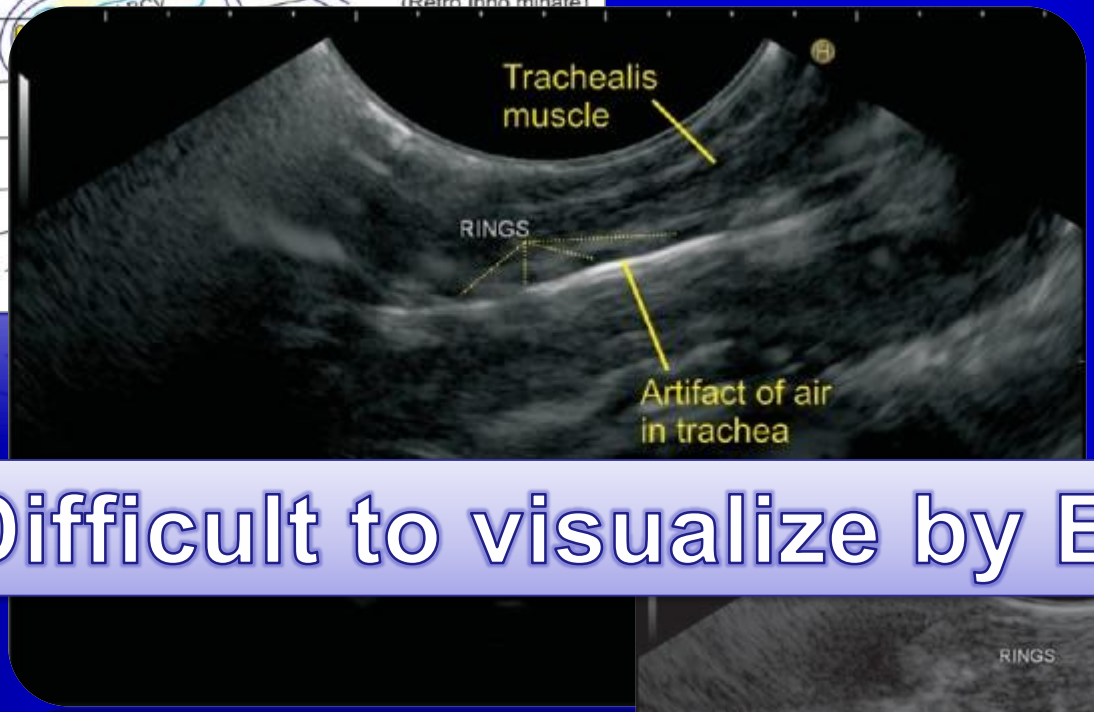
- Imaging of mediastinum: 360° rotation from 4 positions
- Each position has a home base
- Structures are described while doing a clockwise movement after a maximum anticlockwise rotation



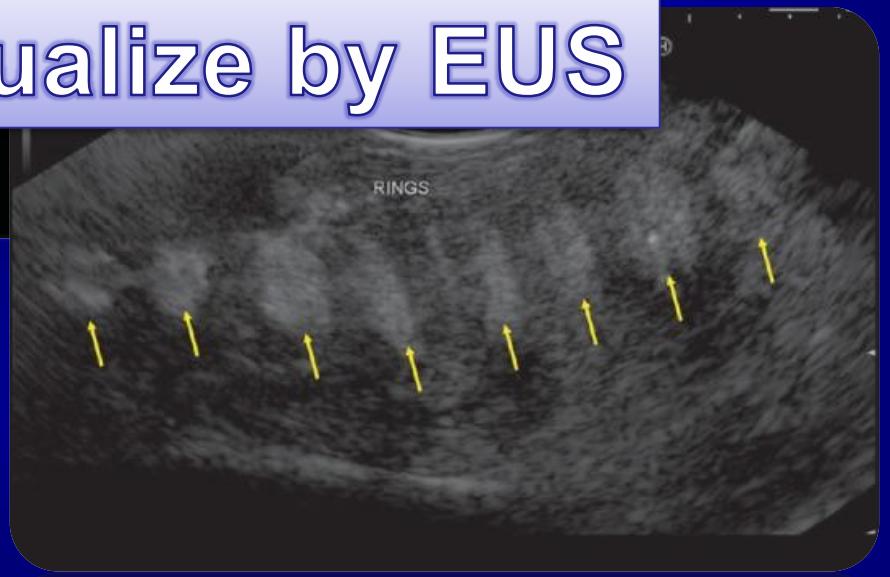
Spaces anterior to trachea

The pretracheal space



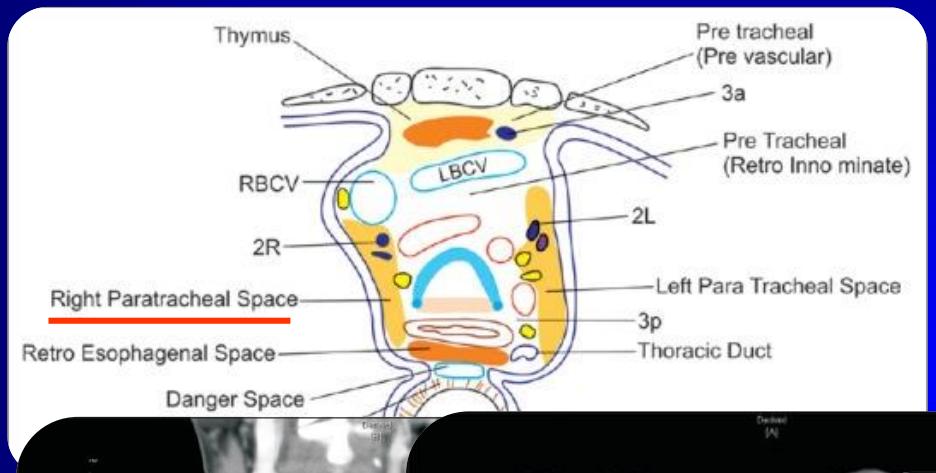


Difficult to visualize by EUS

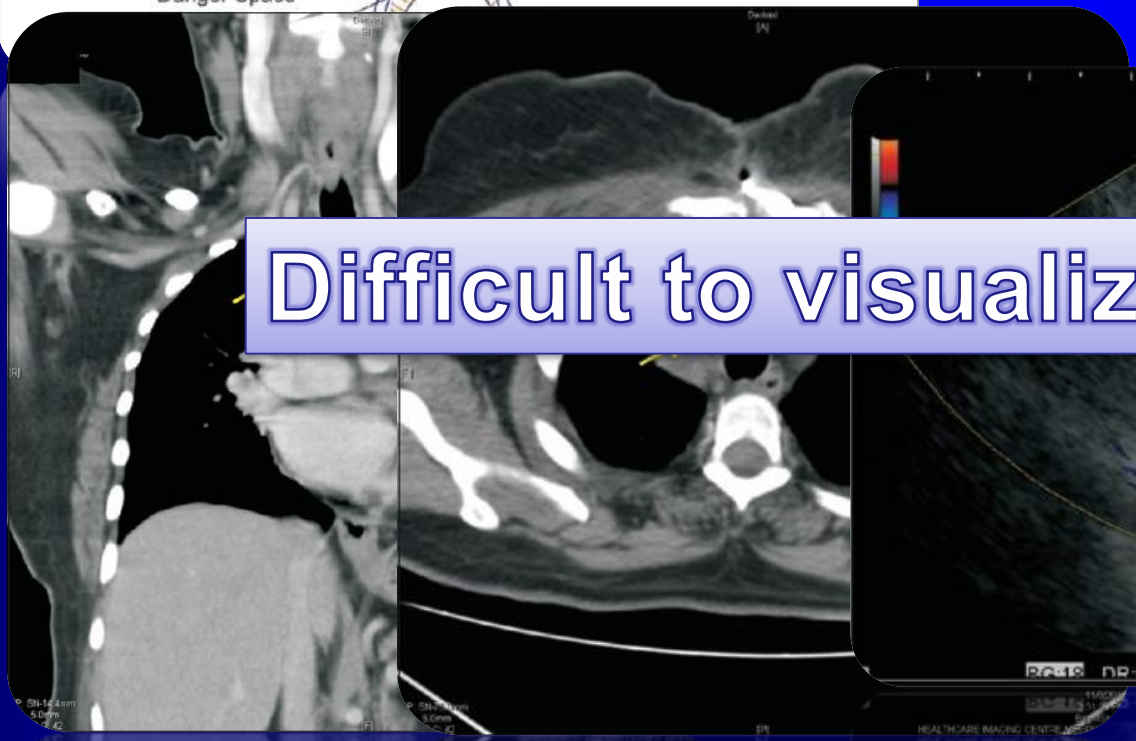


Spaces lateral to trachea

The right paratracheal space



CT coronal scan ➔ small, hypodense peripherally enhancing collection of 32 × 33 mm^2 size in the right paratracheal region abutting the superior vena cava (SVC)

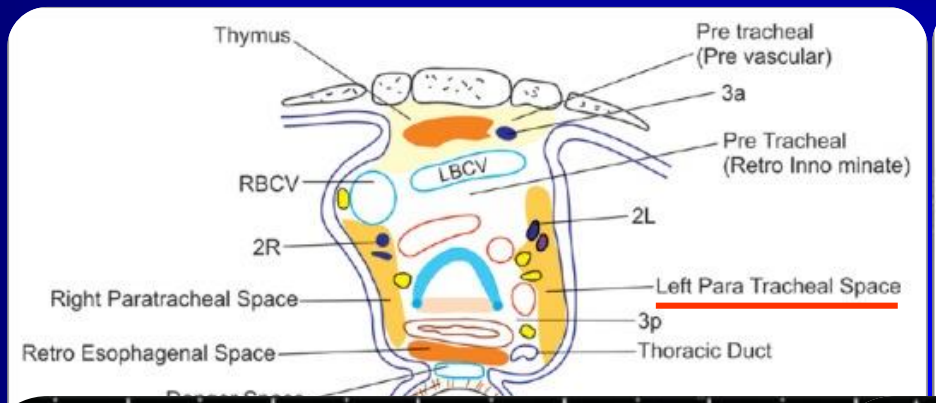


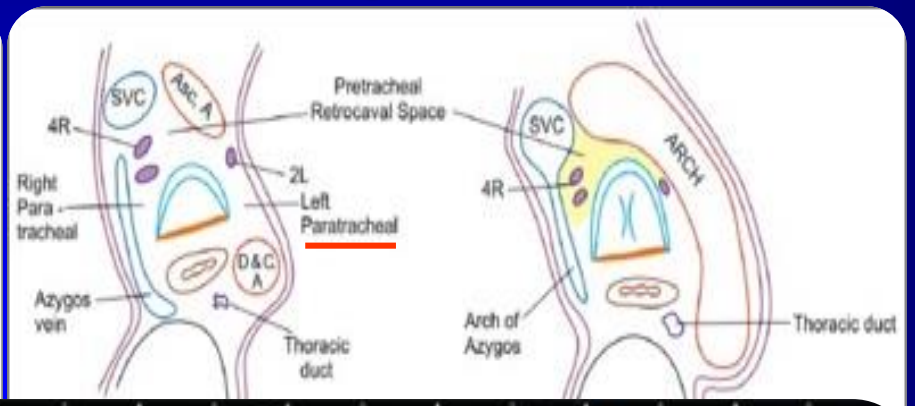


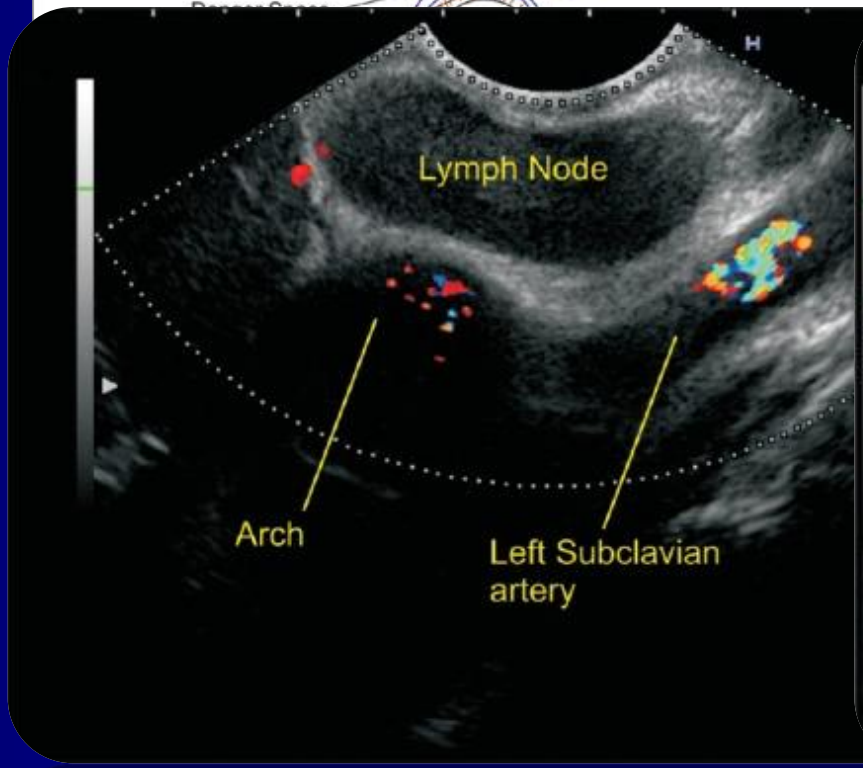
Difficult to visualize by EUS

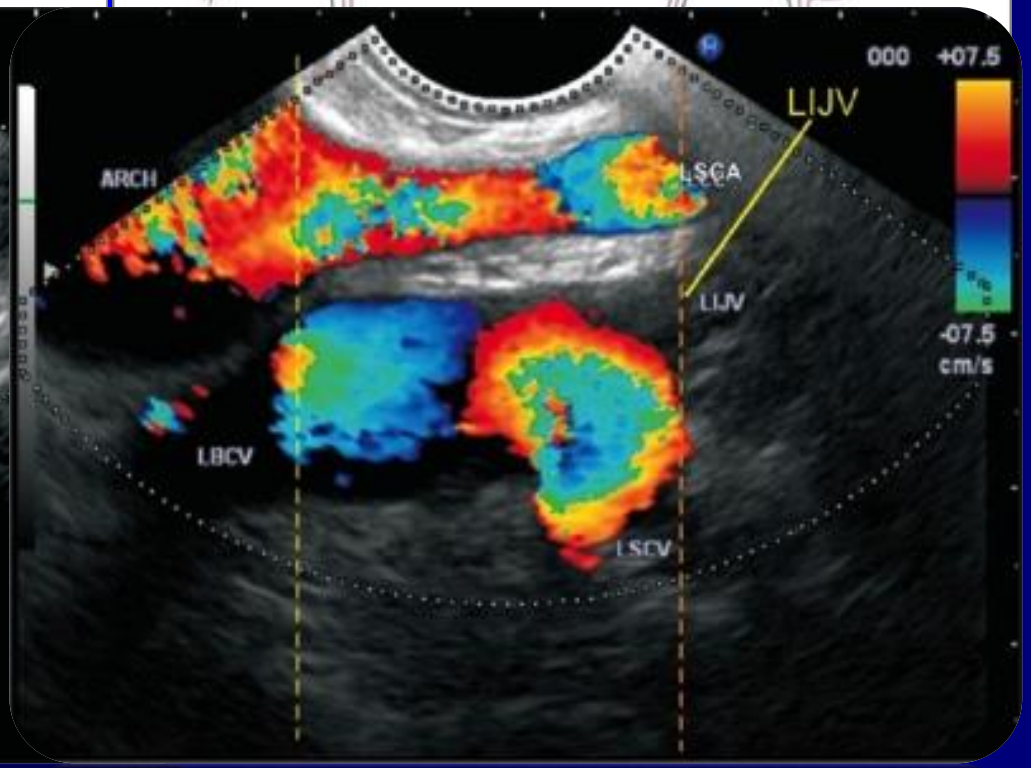
Spaces lateral to trachea

The left paratracheal space





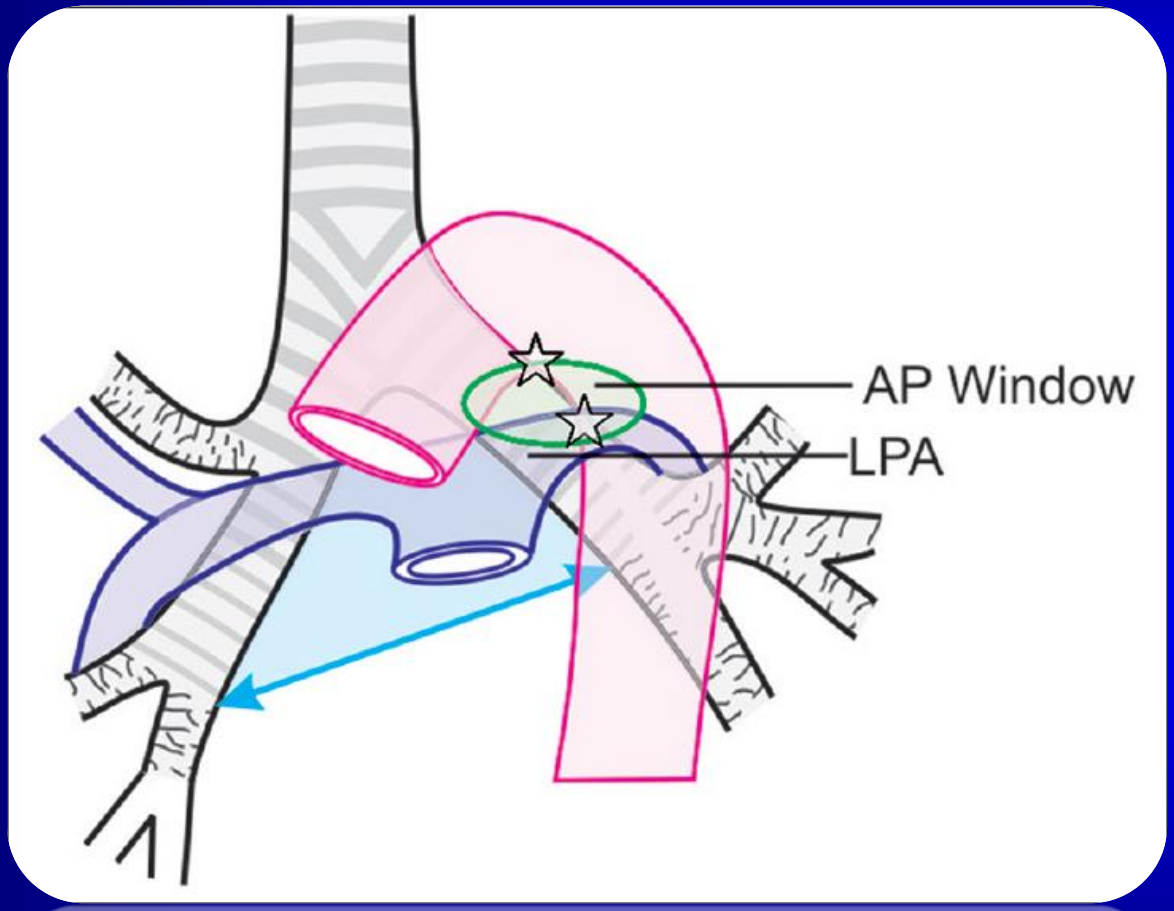




LBCV: left brachiocephalic vein; **LCC:** left common carotid artery; **LIJV:** left internal jugular vein; **LSCV:** left subclavian vein.

Spaces lateral to trachea

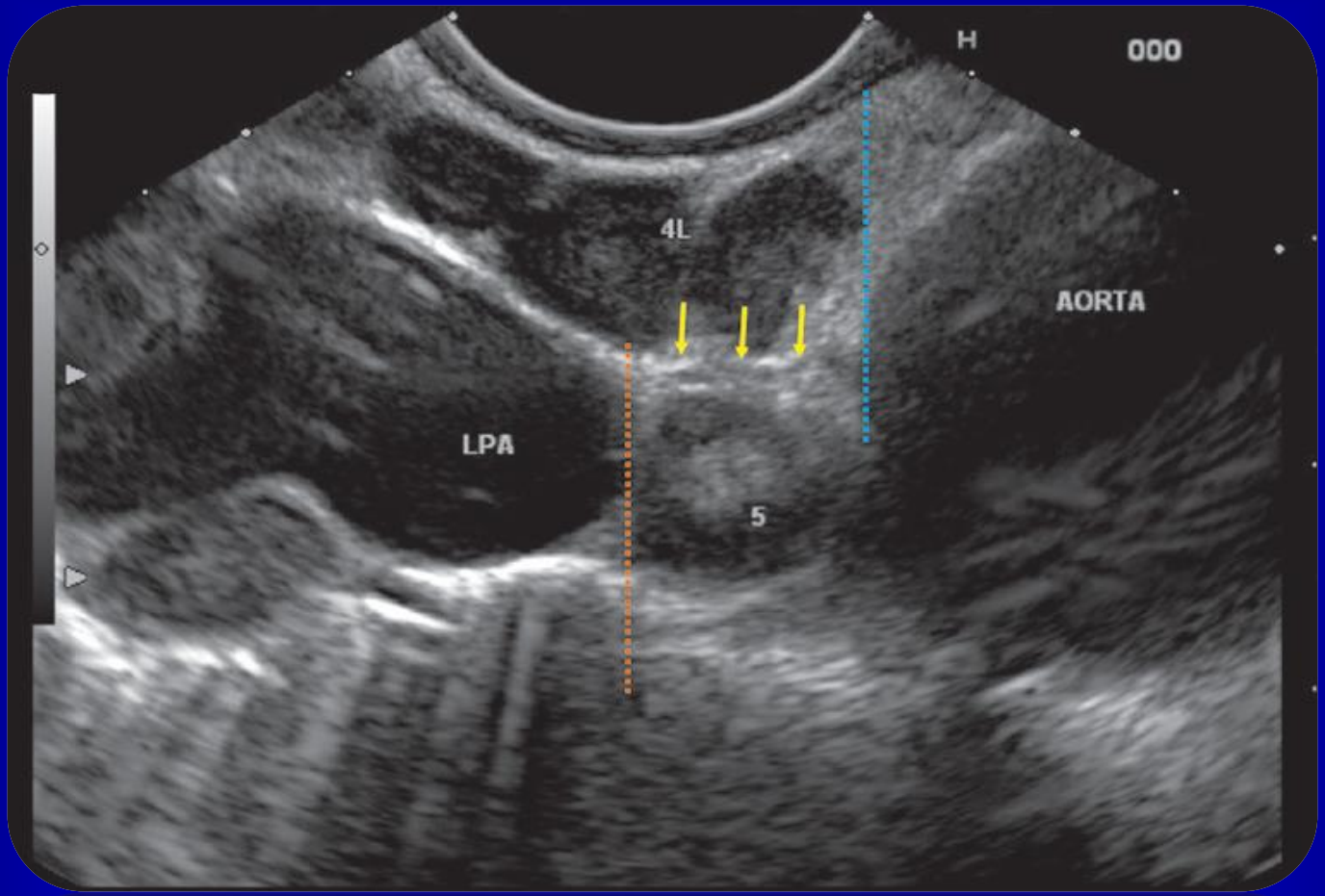
The aortopulmonary window



It is created by the formation of an aortic arch over the left pulmonary artery in the left paratracheal region.

Spaces lateral to trachea

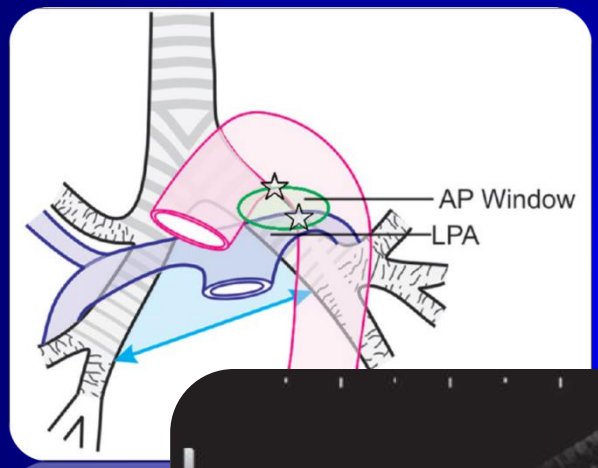
The aortopulmonary window

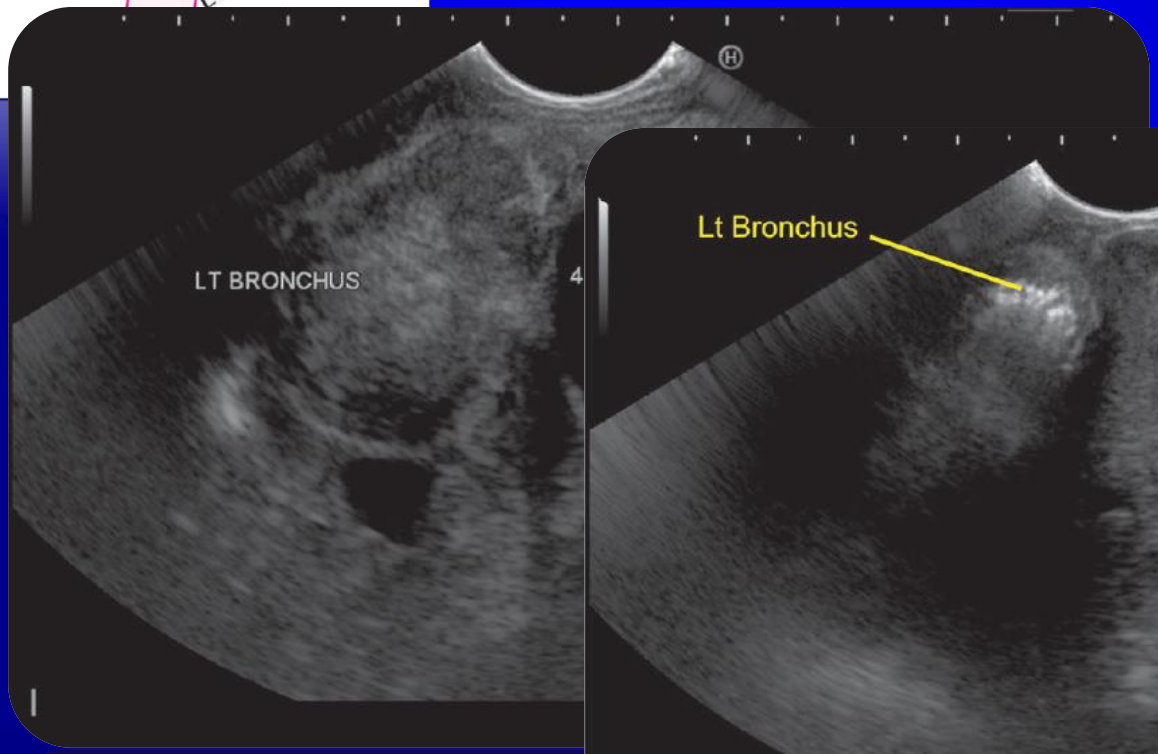


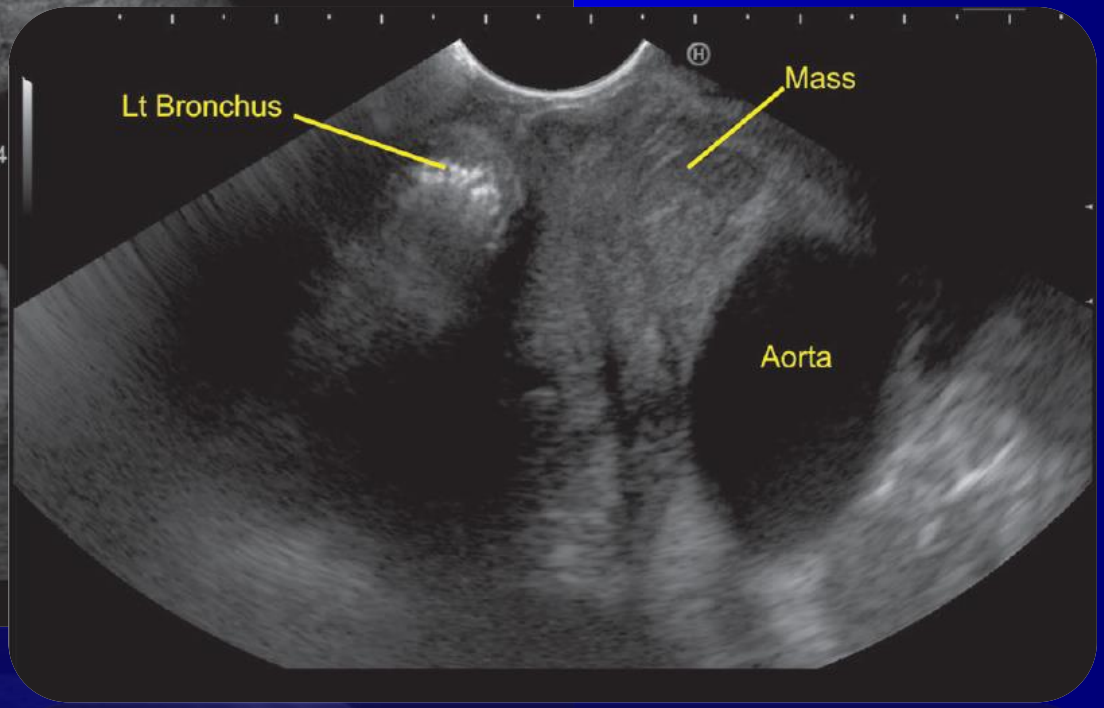
dotted blue line: inferior margin of the aortic arch
dotted orange line: superior margin of the left pulmonary artery
yellow arrows: ligamentum arteriosum

Spaces lateral to trachea

The aortopulmonary window

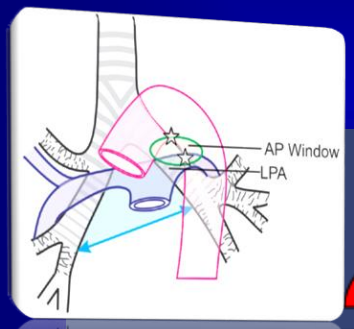


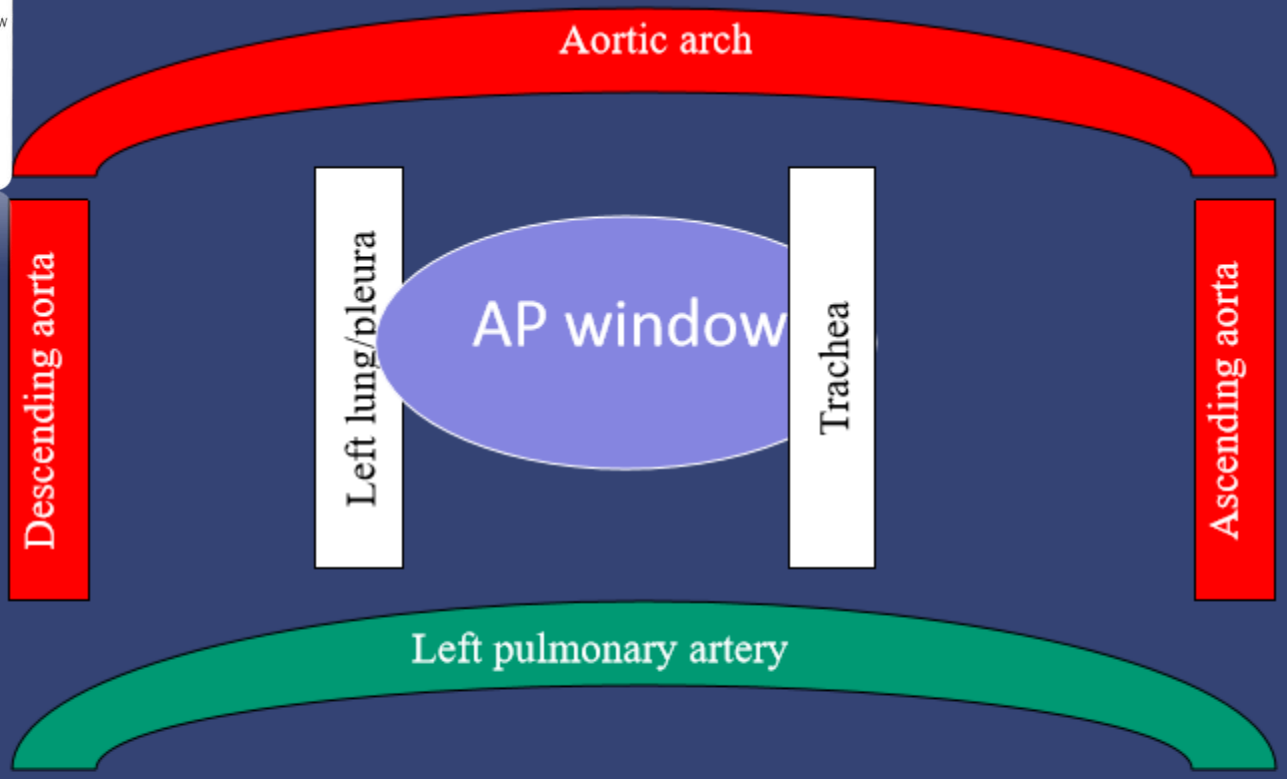




Spaces lateral to trachea

The aortopulmonary window

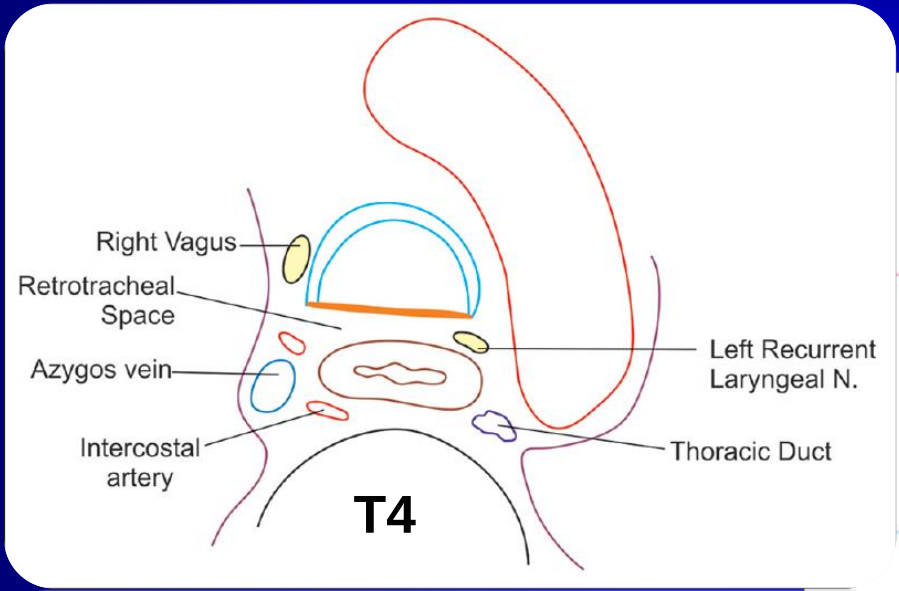


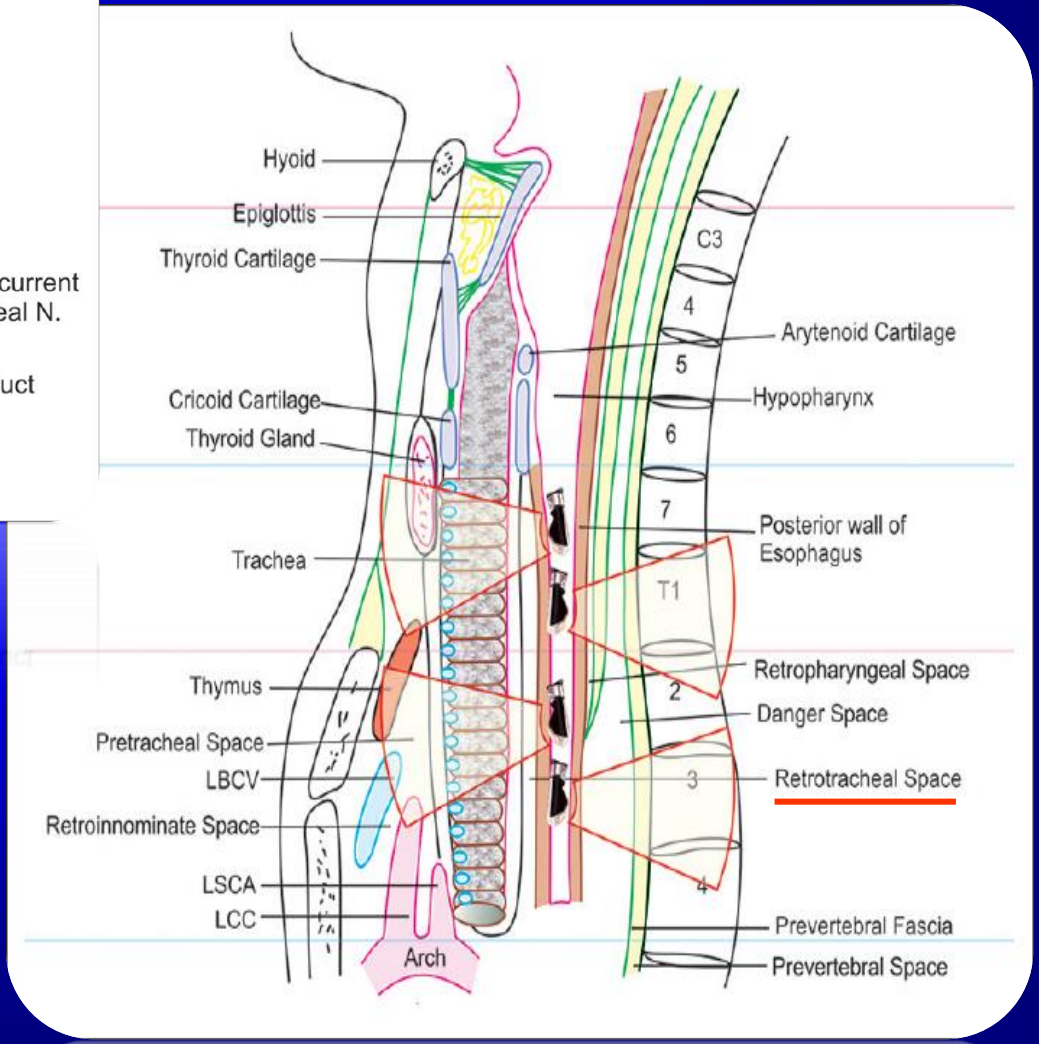


- AP window can be located by clockwise rotation from the point where descending aorta starts making the arch, or by anticlockwise rotation from the right pulmonary artery

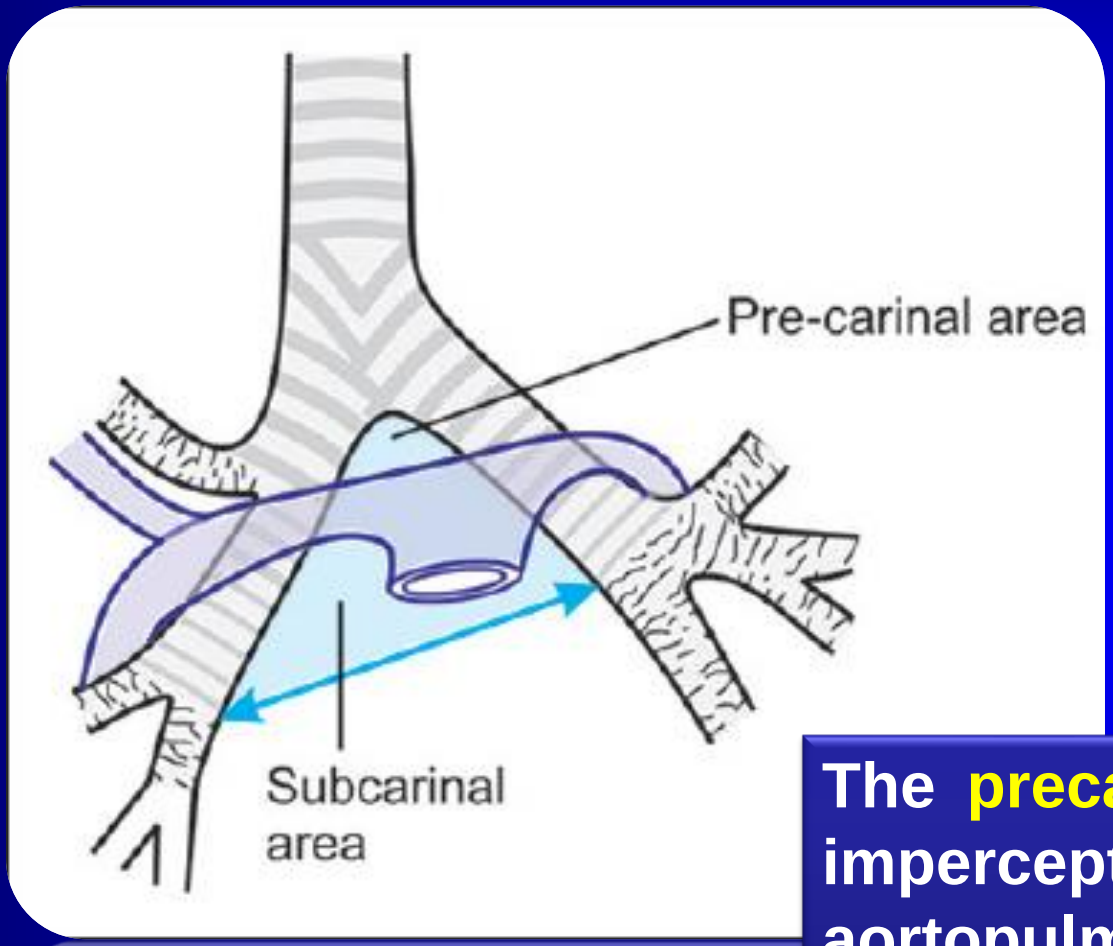
Spaces posterior to trachea

The retrotracheal space





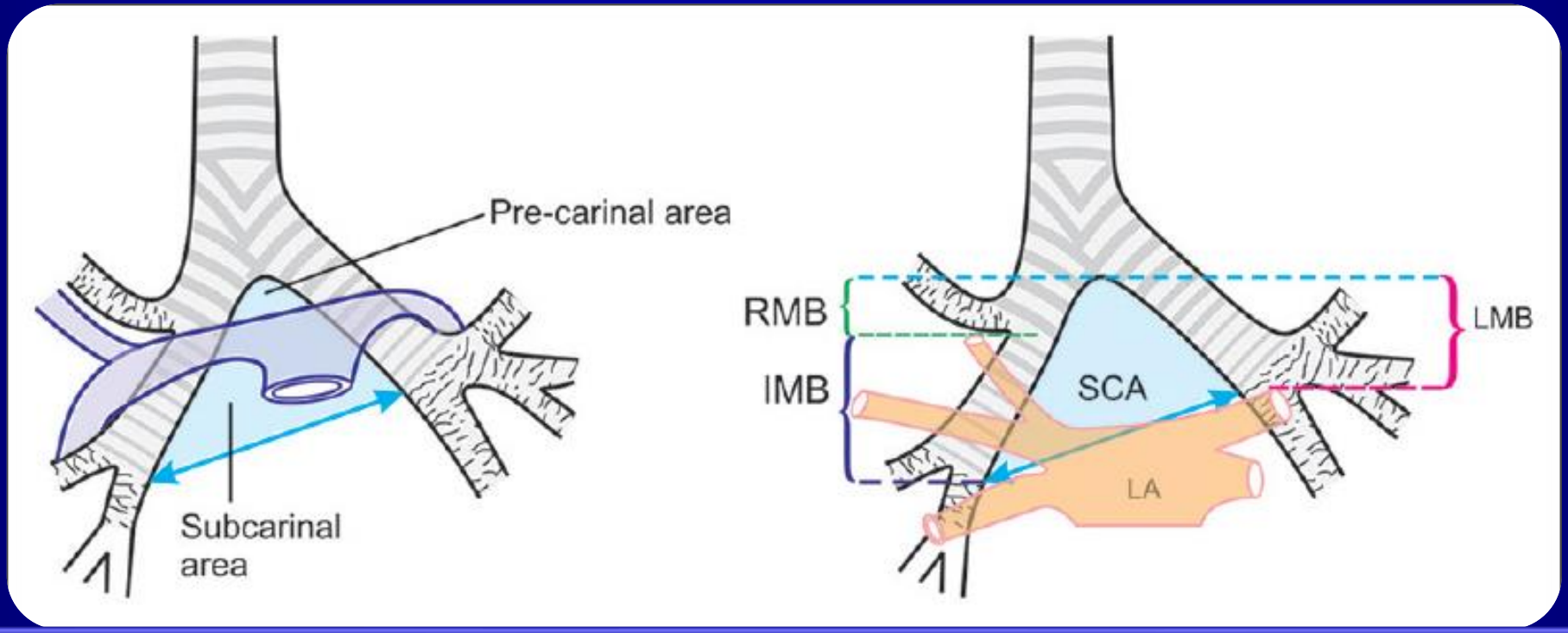
Spaces below trachea
The precarinal space



The precarinal space merges imperceptibly with the aortopulmonary window on the left and continues below into the subcarinal area

Spaces below trachea

The subcarinal space



Tip: tracheal bifurcation

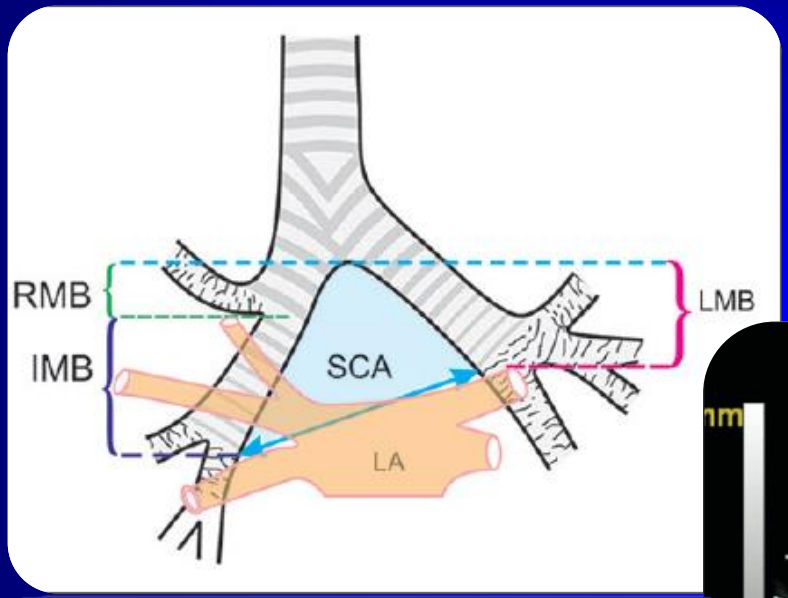
Right boundary: right bronchus - RMB (~2.5 cm) and intermediate bronchus - IMB (~2.5 cm)

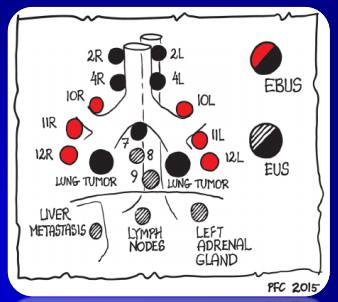
Left boundary: left main bronchus (~5 cm)

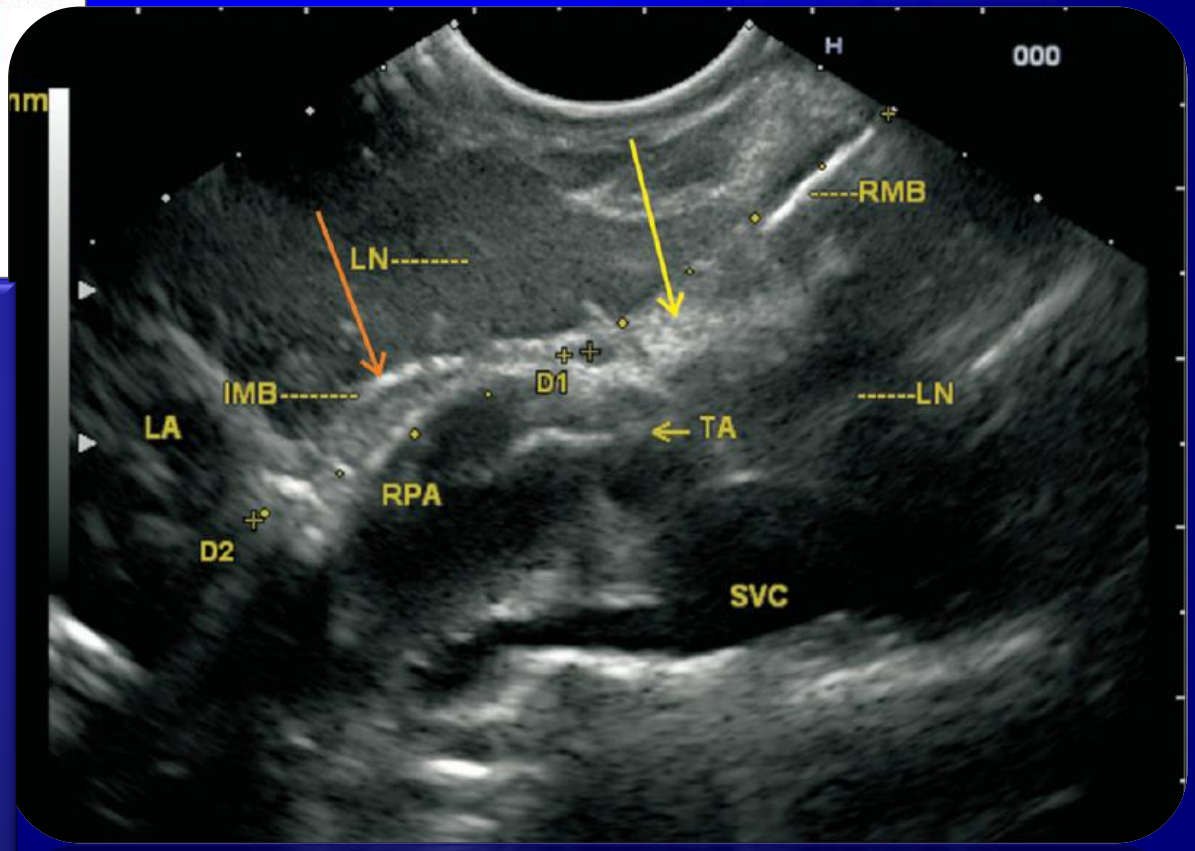
Lower limit: an oblique line drawn from the lower border of the IMB to the lower border of the LMB and (also defined by the upper border of the left atrium) (~3-4 cm in breadth).

Spaces <u>below</u> trachea

The subcarinal space



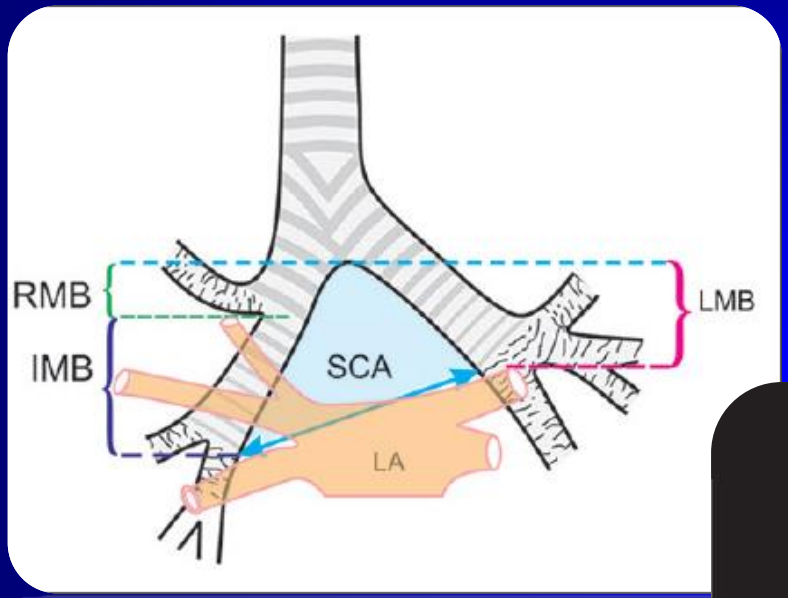




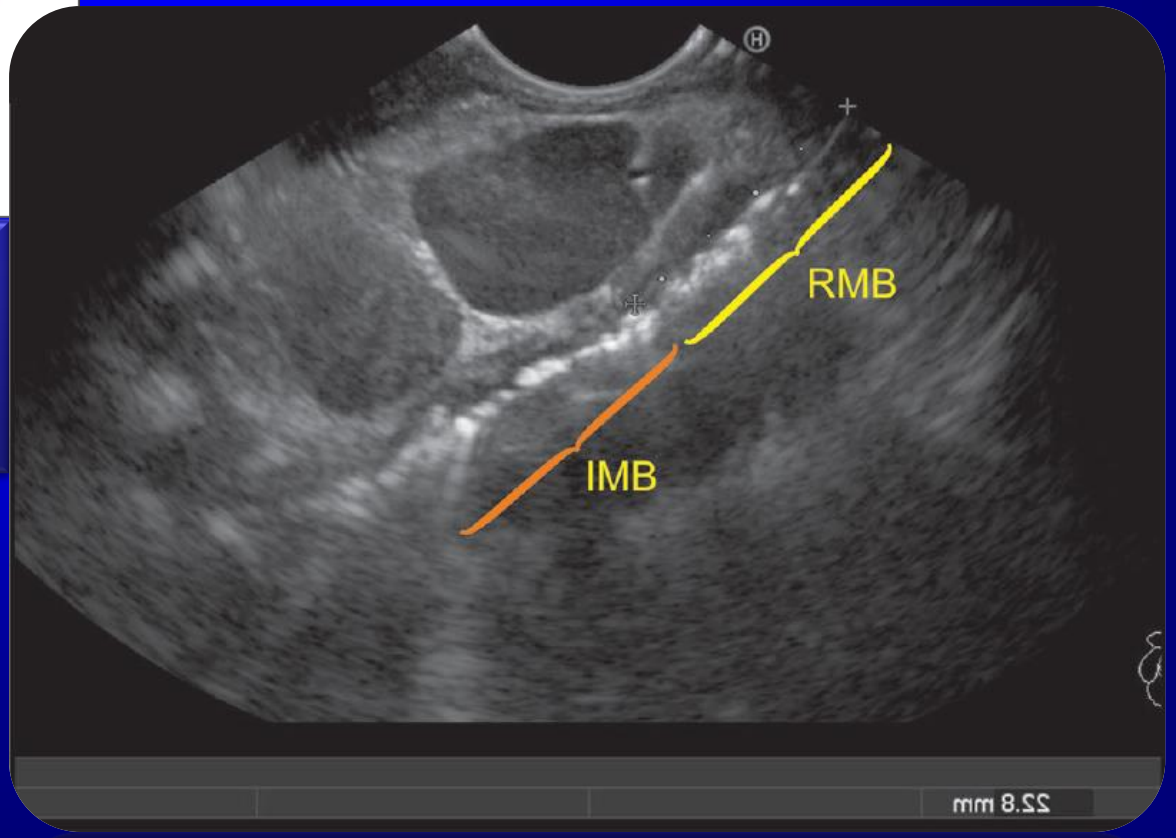
Yellow arrow: right main bronchus,
RMB: Right main bronchus,
Orange arrow: Intermediate bronchus,
IMB: Intermediate bronchus,
RPA: Right pulmonary artery,
SVC: Superior vena cava,
LA: Left atrium

Spaces <u>below</u> trachea

The subcarinal space

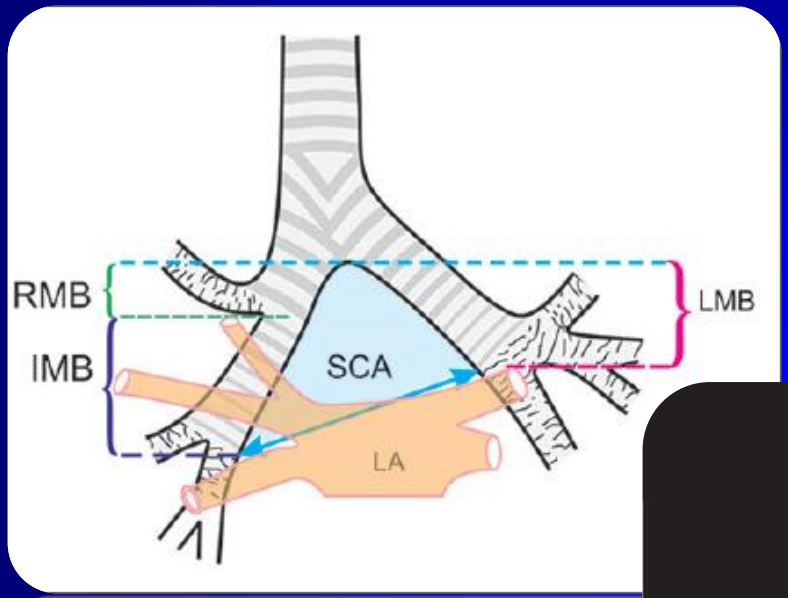


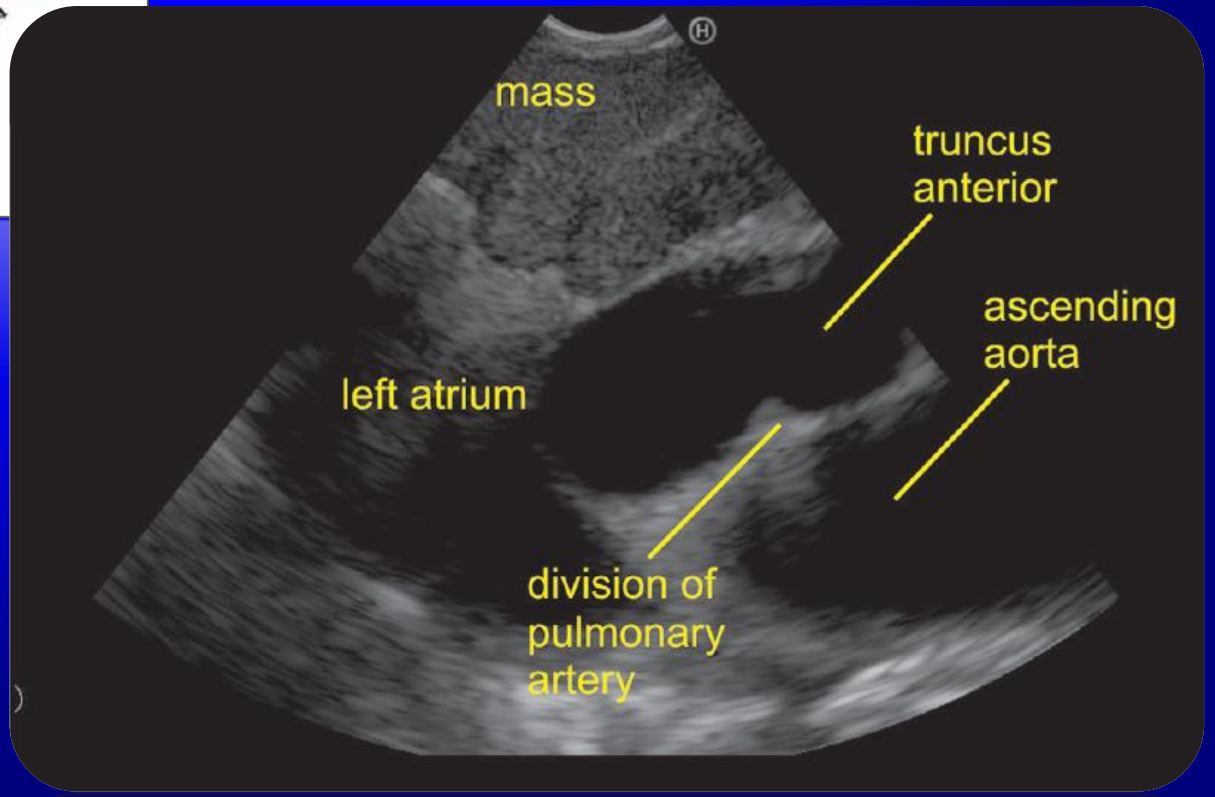
Yellow arrow: right main bronchus,
Orange arrow: Intermediate bronchus



Spaces <u>below</u> trachea

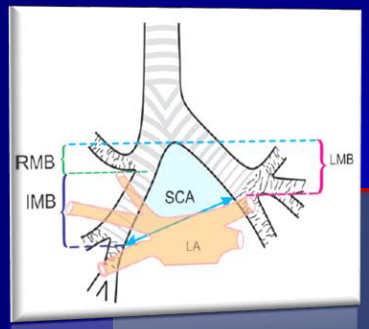
The subcarinal space





Spaces <u>below</u> trachea

The subcarinal space



Trachea

↓

25-26 cm

↙ ↘

Right bronchi
(clockwise rotation)

Left bronchi
(anticlockwise rotation)

Subcarinal area

↓

- Right pulmonary artery
- Superior vena cava

] Clockwise rotation

Spaces <u>below</u> trachea

Middle esophagus

(below the arch of aorta – 25-30 cm)

HOME BASE

posterior

anterior

Descending aorta

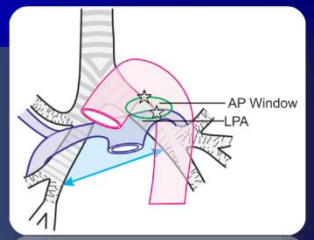
Esophagus

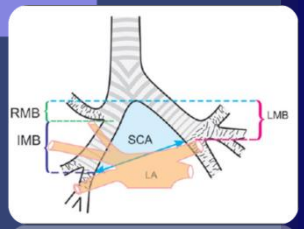
Pulmonary artery

Aortopulmonary (AP) window

Subcarinal area

Left atrium

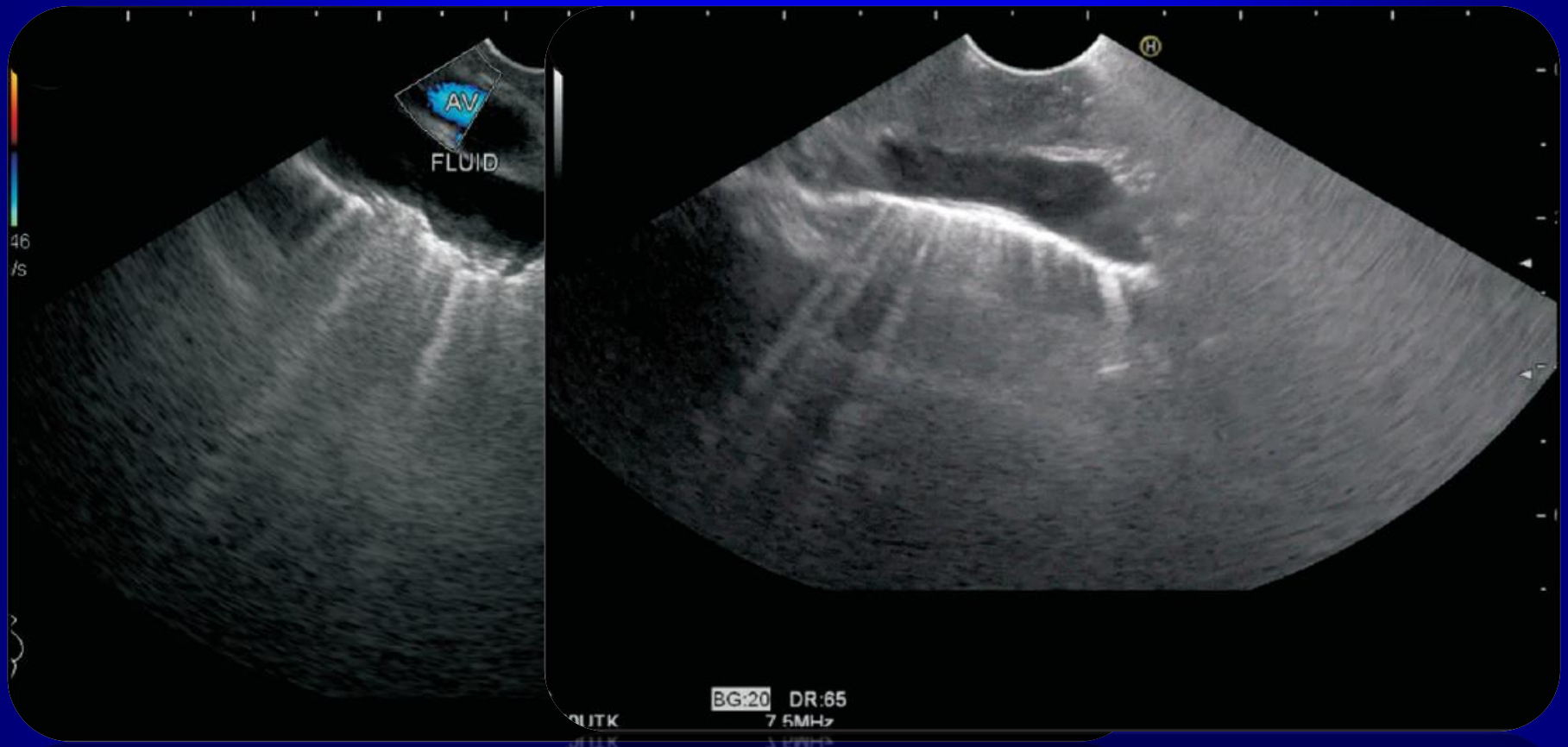




Spaces <u>below</u> trachea

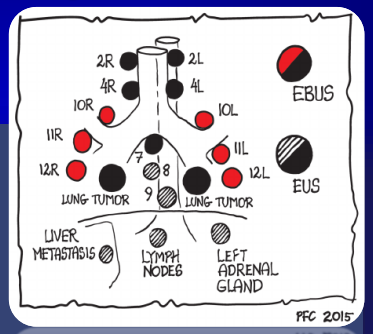
The azygoesophageal recess

It is the interface between the right lower lobe of the lung and the mediastinal reflection inferior to the arch of the azygos vein



To resume

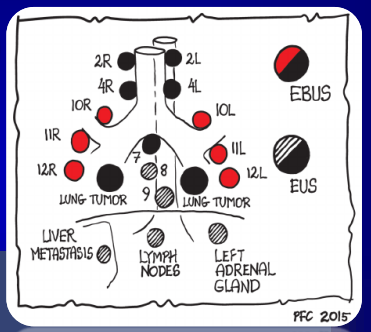
EUS region 8-9 (distal esophagus)



- Place the tip in the distal esophagus
- Aorta as the starting point (and home base)
- Rotate 180 degrees (alternatively clockwise and counterclockwise) from the aorta the return
- Repeat with 1-2 cm steps to explore region 8

To resume

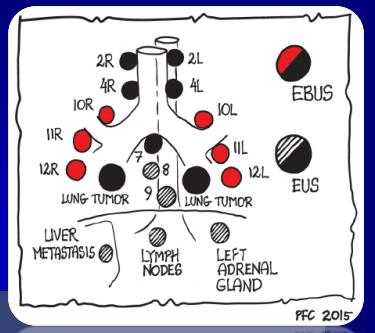
EUS region 7 (subcarinal space)



- From DAO at 35-40 cm rotate 180 degrees clockwise
- Withdraw until left atrium is seen (usually 35 cm from the incisors)
- Withdraw slowly placing left atrium on the left of the screen and pulmonary artery appear on the right

To resume

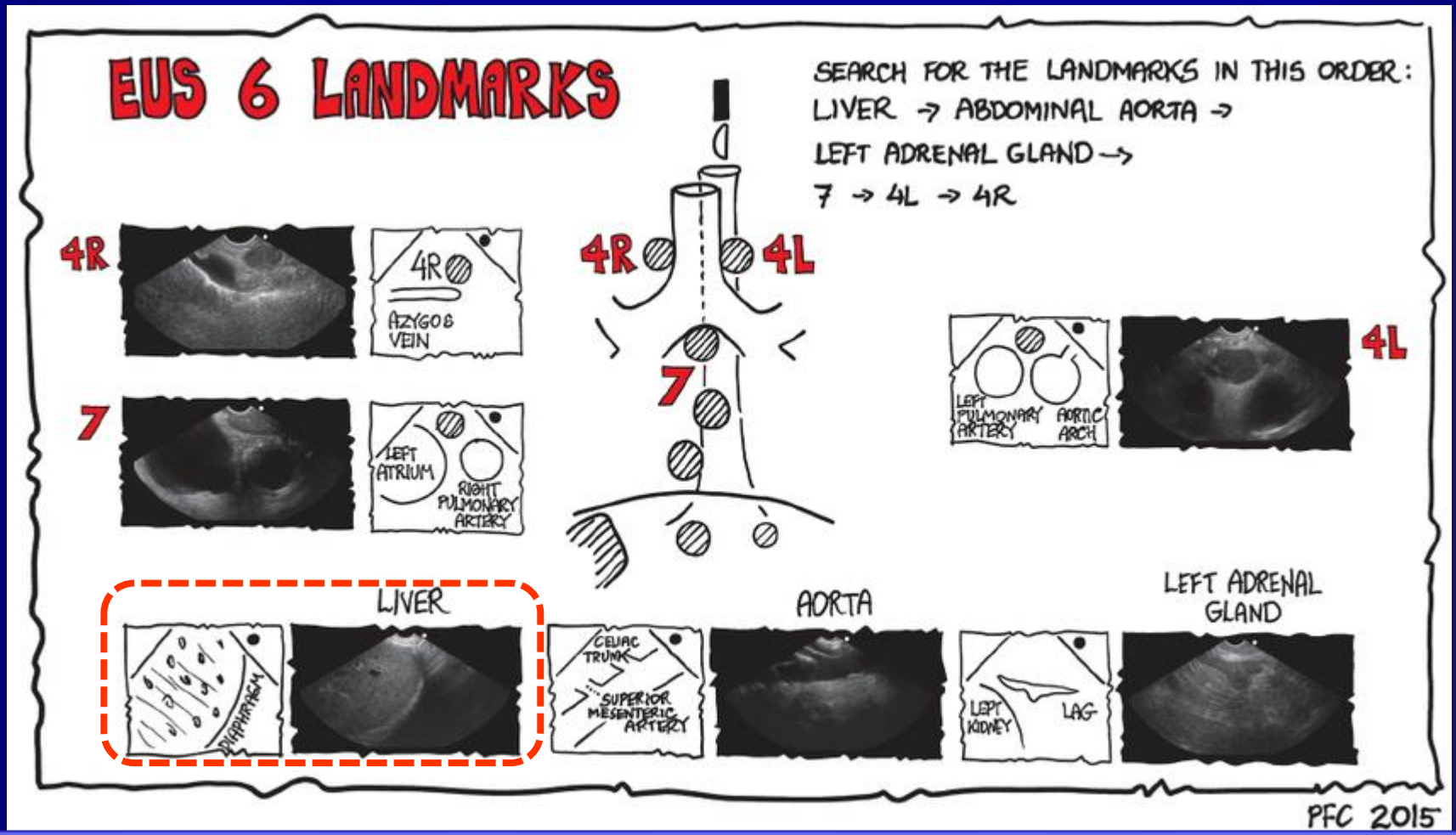
EUS aortopulmonary window



- Starting from DAO (middle esophagus) until the aortic arch
- Advance the scope 1 cm
- Rotate 60 degrees clockwise
- Slightly up the tip to show the pulmonary artery on the left side of the screen

To resume

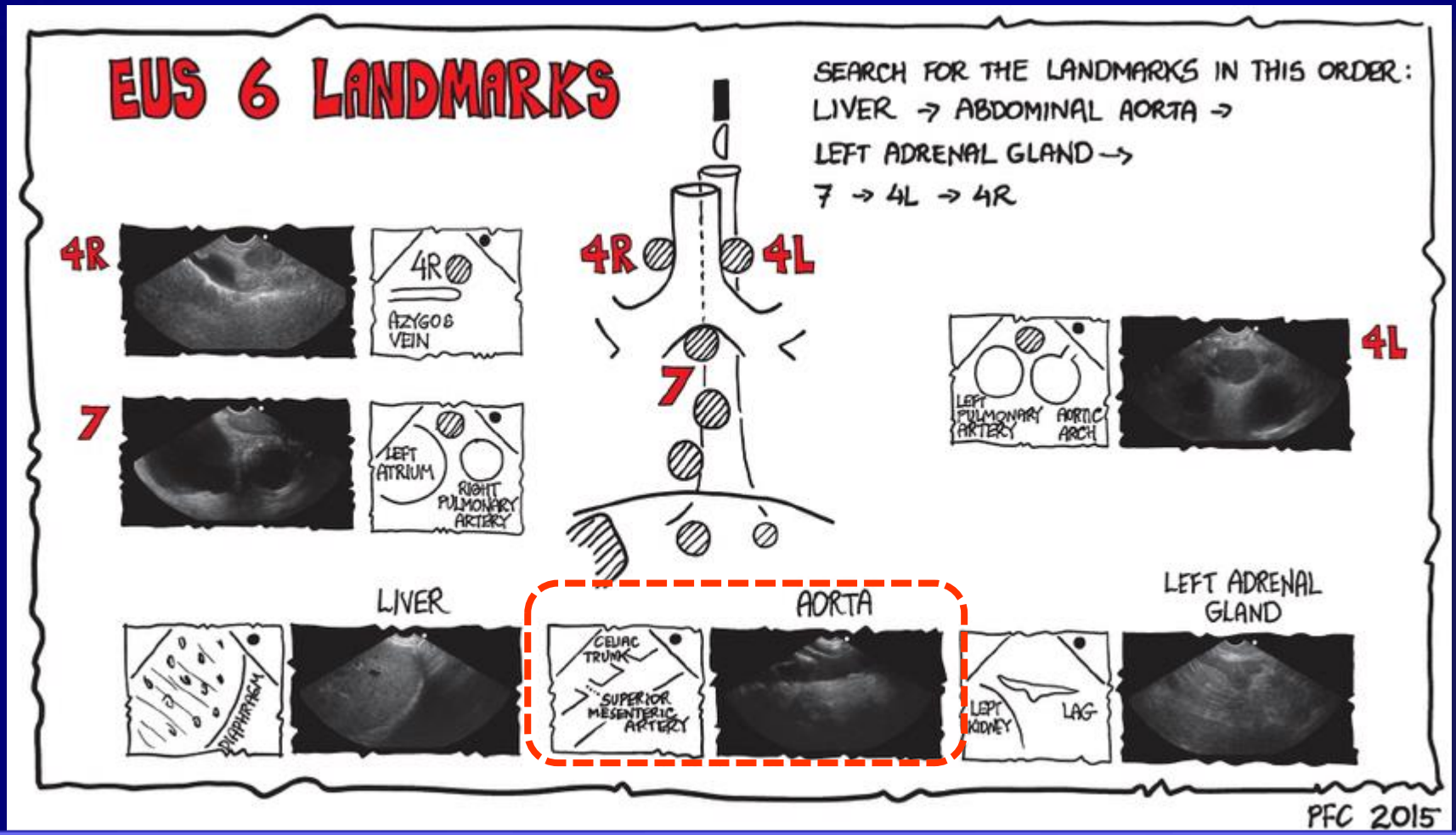
The six EUS landmark



Liver (landmark I): introduce the endoscope into the esophagus and slide down below the diaphragm. Turn the endoscope counterclockwise to find the left liver lobe.

To resume

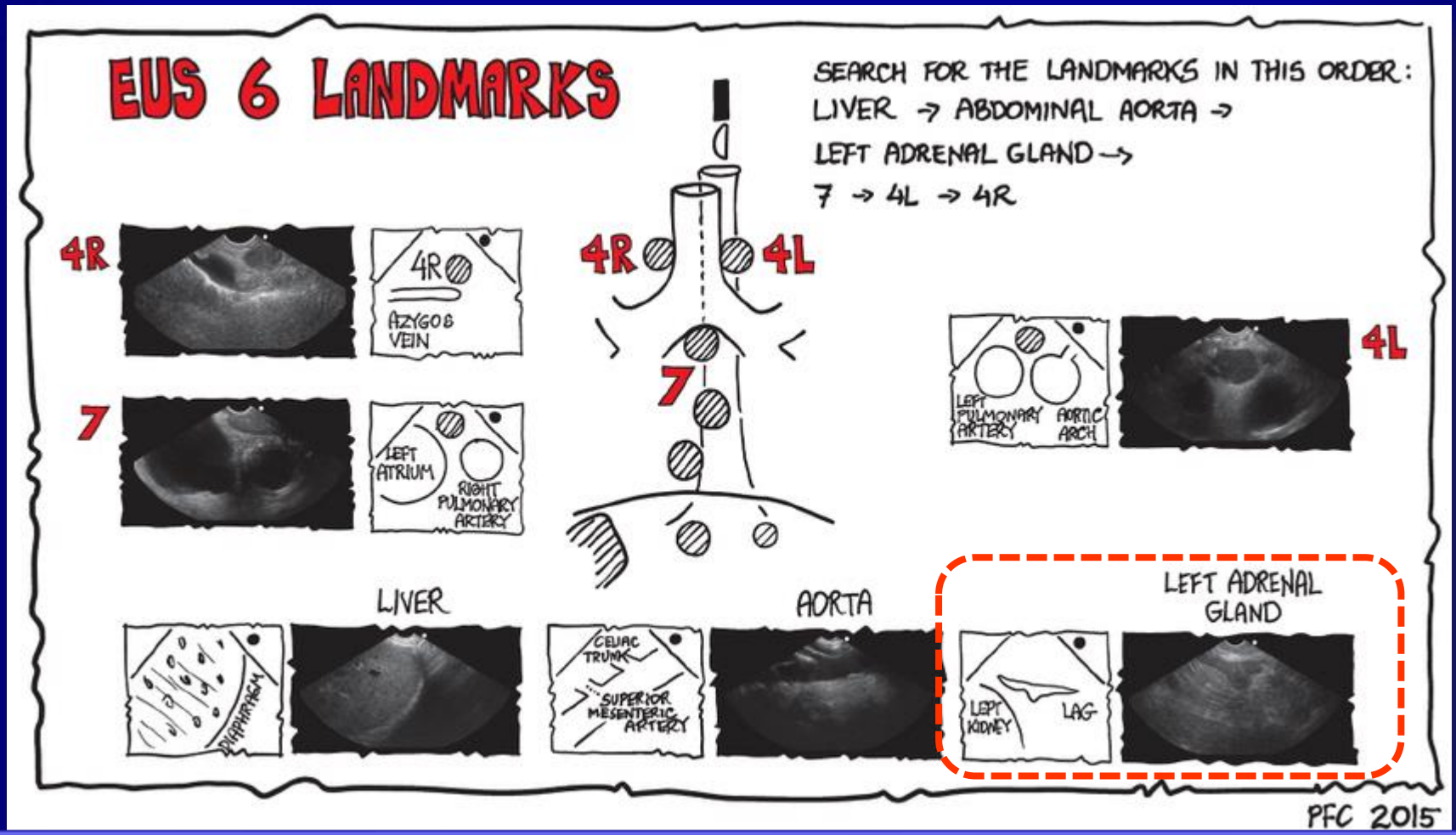
The six EUS landmark



Aorta (landmark II): turn the endoscope clockwise and find the aorta with the celiac trunk and the superior mesenteric artery.

To resume

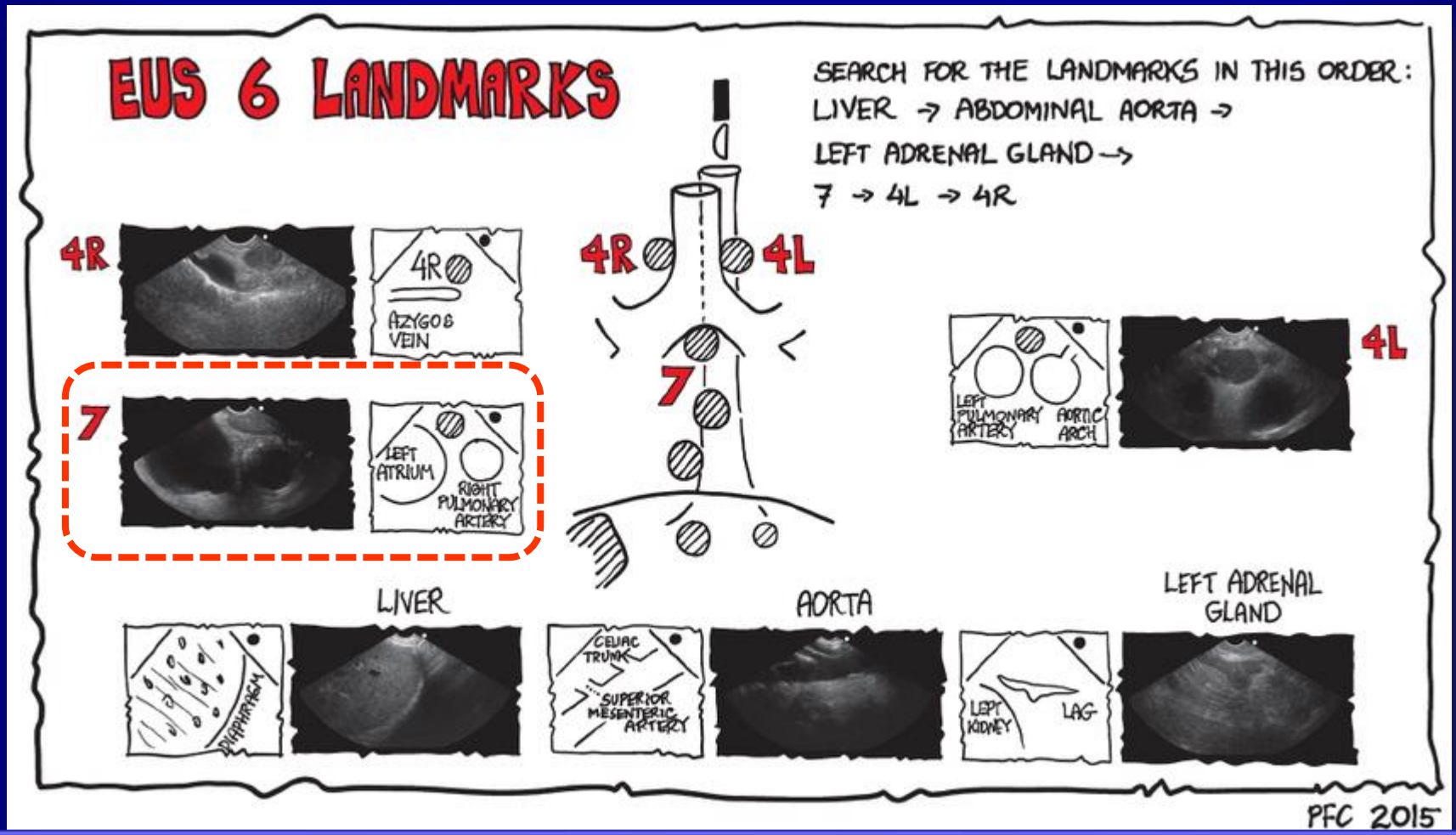
The six EUS landmark



The left adrenal gland (landmark III): turn the endoscope further clockwise, move the transducer a little upwards to find the left adrenal gland (it resembles a small bird, seagull) close to the upper pole of the left kidney.

To resume

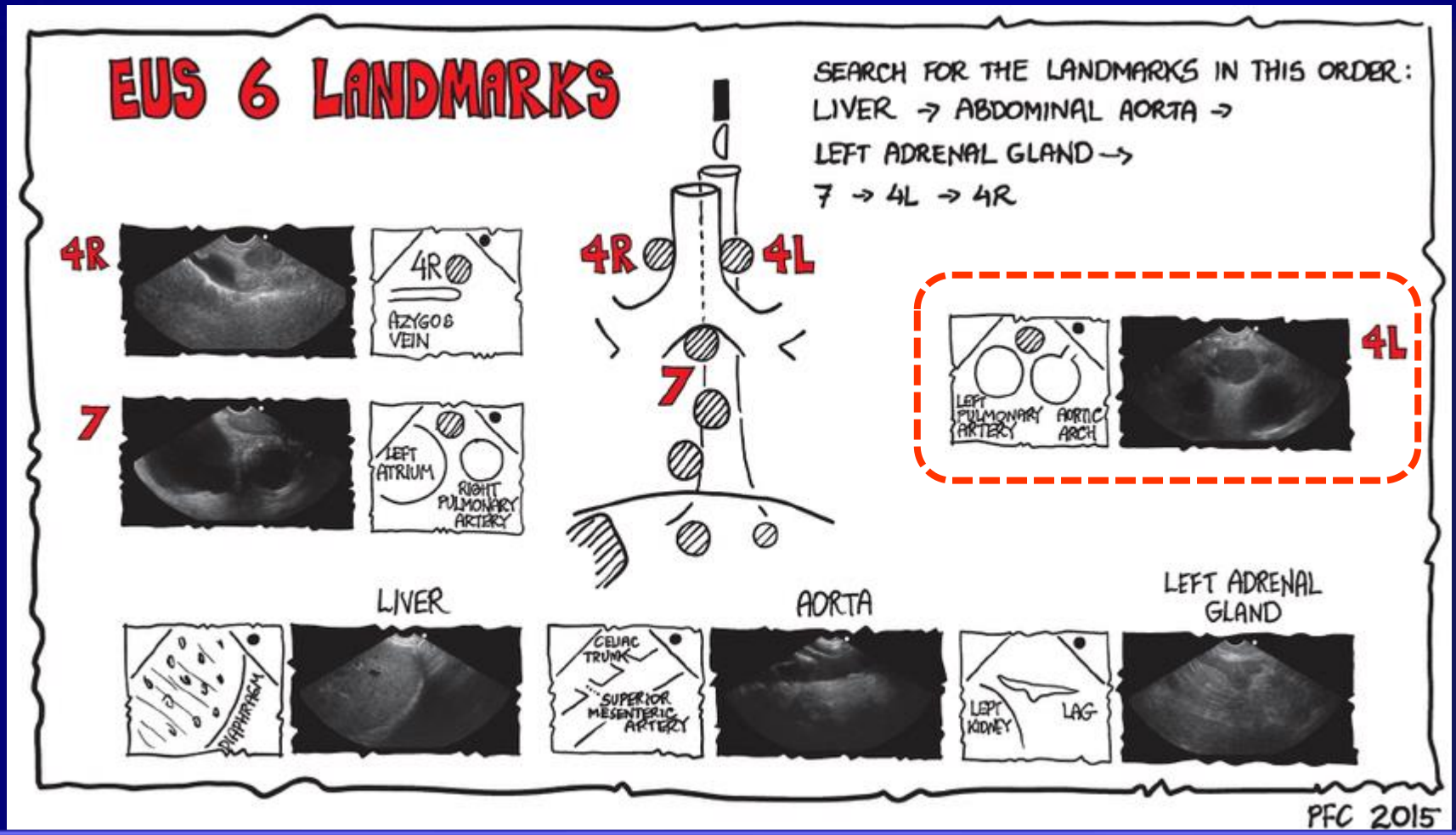
The six EUS landmark



Station 7 (landmark IV): retract the endoscope to the mediastinum and find station 7 below the carina close to the left atrium and the right pulmonary artery.

To resume

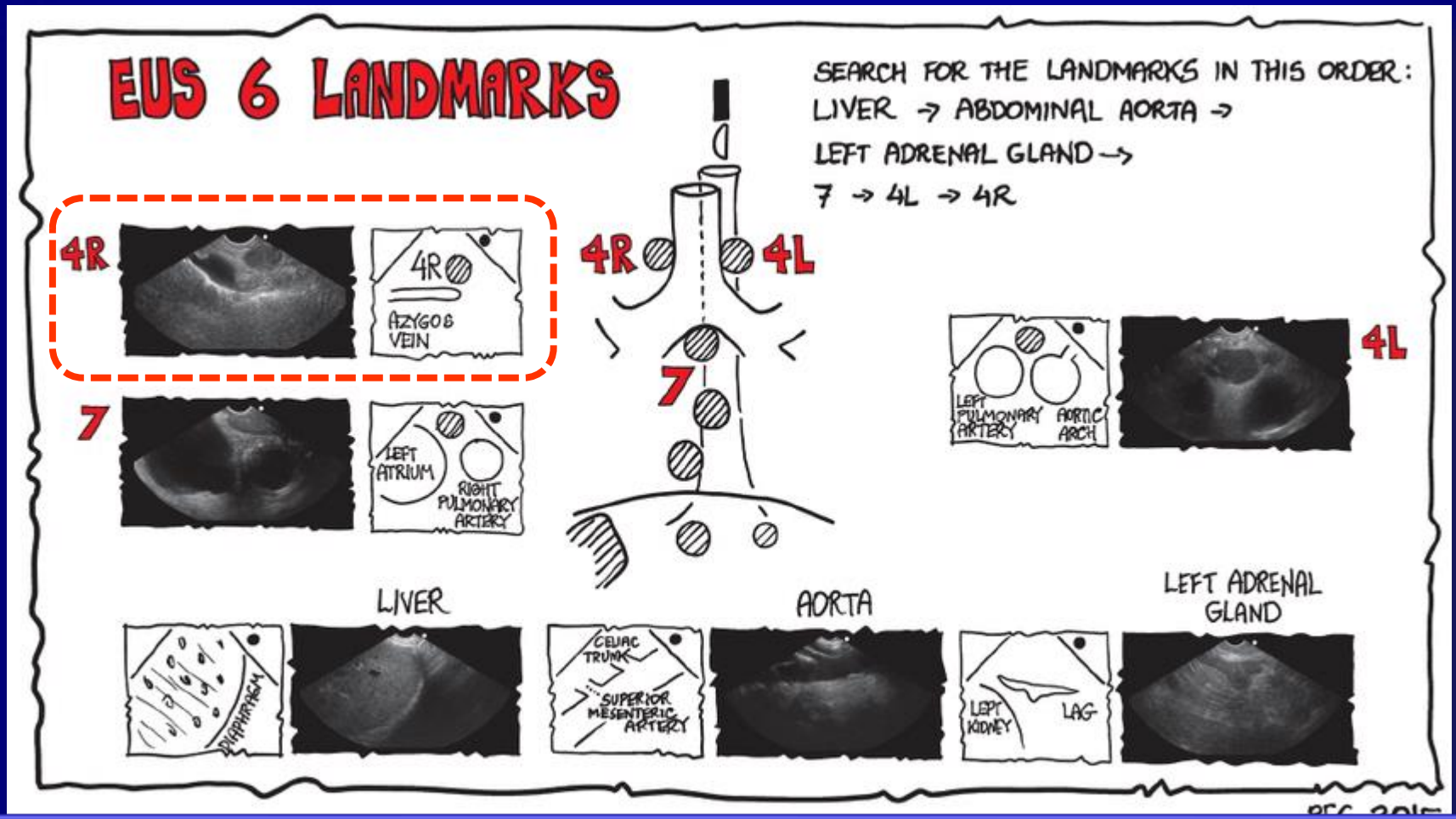
The six EUS landmark



Station 4L (landmark V): retract the endoscope a few centimeters, turn counterclockwise and find station 4L between the aortic arch and the left pulmonary artery (the vessels resemble the *ears of Mickey Mouse*)

To resume

The six EUS landmark



Station 4R (landmark VI): turn clockwise until you pass the trachea and find the azygos vein. Retract the endoscope slowly until the vein disappears into the superior cava vein and search for station 4R. If it is of normal size, it will, often hide behind the trachea.

CONCLUSIONS

- The trachea and the esophagus pass through the center of the mediastinum and are responsible for the formation of many spaces.
- The description of the spaces in the mediastinum generally coincides with lymph node stations as described in IASLC (The International Association for the Study of Lung Cancer) classification.
- Knowledge of the spaces is important to head, neck, and thoracic surgeons because these anatomic areas are used daily for radiographic interpretation as well as for the performance of surgical procedures.
- The evolution of CT technology has improved detection of these spaces, and more detailed imaging is now routinely pursued before planning management strategies.
- Knowledge of the typical locations and of typical and atypical appearances on EUS can prevent misdiagnosis and help in appropriate management.



Grazie per l'attenzione!