MIDLANDS SURGICAL ANATOMY TEACHING SERIES

MSATS HANDOUT 2021/22

High Yield | Surgical Relevance | CPD Accredited

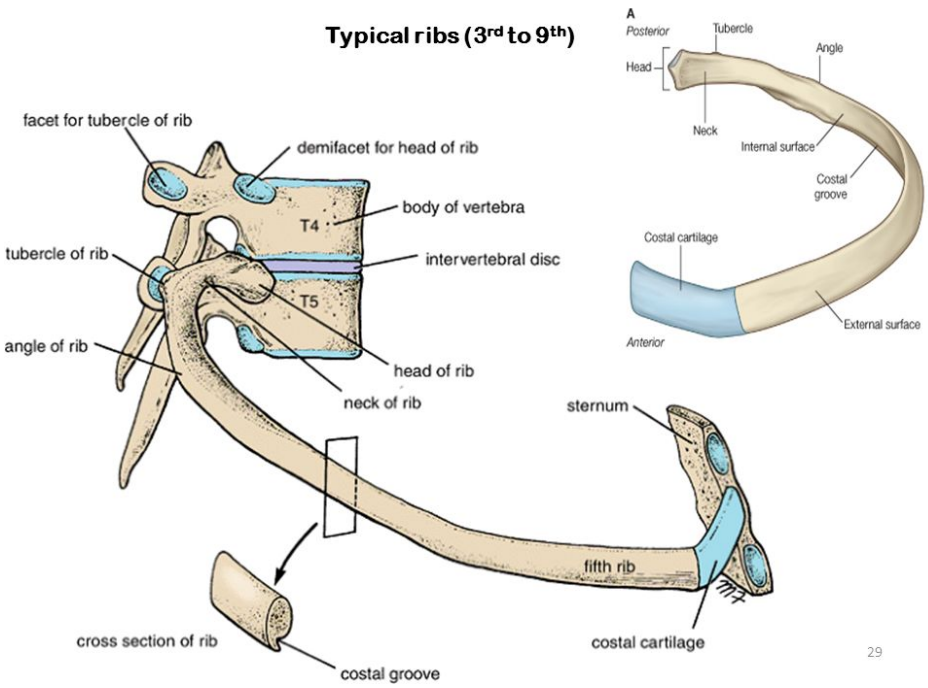
THORAX ANATOMY

***Objectives**: Understand the bony anatomy of the thorax, the neurovascular bundle, the gross anatomy of the lungs & pleura. Apply anatomical knowledge in the context of a lobectomy and chest drain insertion.*

Bony Anatomy

- The thorax extends from the superior thoracic aperture to the inferior thoracic aperture.
- Components of the thoracic wall:
  - **12 thoracic vertebrae** & intervertebral discs (posteriorly)
  - **12 ribs**
  - **Sternum** (manubrium, body and xiphoid process)

- Each ribs possesses 3 articulates with thoracic vertebrae:



Articulation 1 - Head of rib articulates with body of respective vertebra and body of vertebra above.

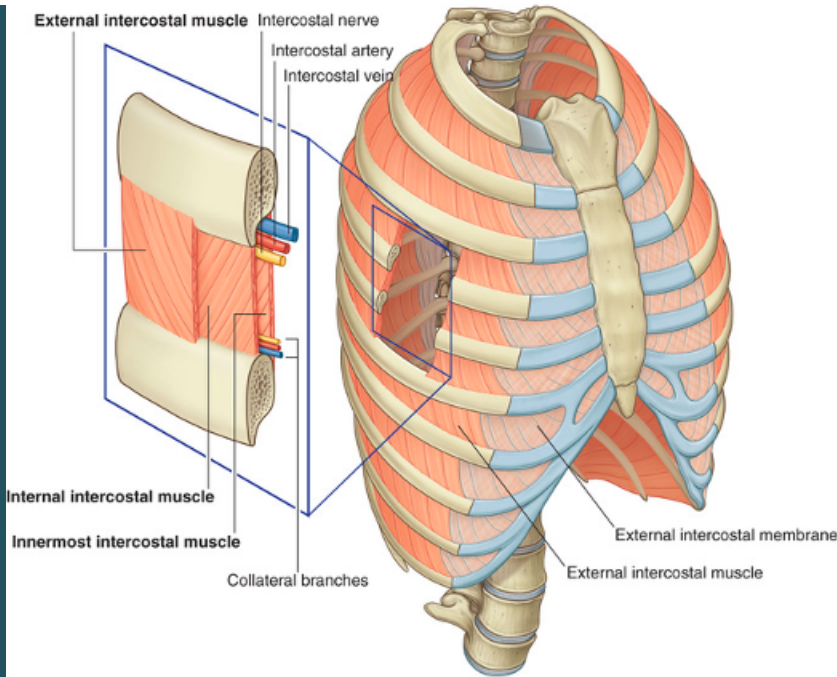
Articulation 2 - Rib tubercle articulates with transverse process of respective vertebra

Articulation 3 - anterior articulation of rib with sternum (ribs 1-7) or costal cartilages (ribs 8-10). Ribs 11-12 have no articulation and are considered 'floating ribs'!

Neurovascular Bundle

- Intercostal spaces lie between ribs and contain intercostal muscles.
- The **neurovascular bundle** consists of an intercostal vein, artery and nerve (*superior to inferior*) which lies in the costal groove of the inferior margin of the superior rib.
- Small collateral branches may be found on the superior aspect of the inferior rib.

Skin -> Subcutaneous fat -> External intercostal m. -> Internal intercostal m. -> Neurovascular bundle -> Innermost intercostal m. -> Endothoracic fascia -> Parietal pleura



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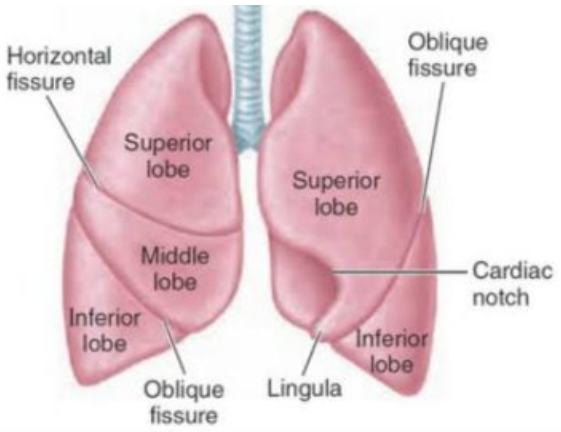
Gross Anatomy of Lungs

- ·Surfaces of the lung
  - Diaphragmatic surface – adjacent to diaphragm
  - Costal surface – adjacent to ribs
  - Mediastinal surface – adjacent to mediastinum
- Bronchial tree: trachea -> right and left main bronchus (at carina, T4/T5) -> lobar bronchi (right lobar branch to superior lobe originates from root of lung) -> segmental bronchi -> **bronchopulmonary segments**

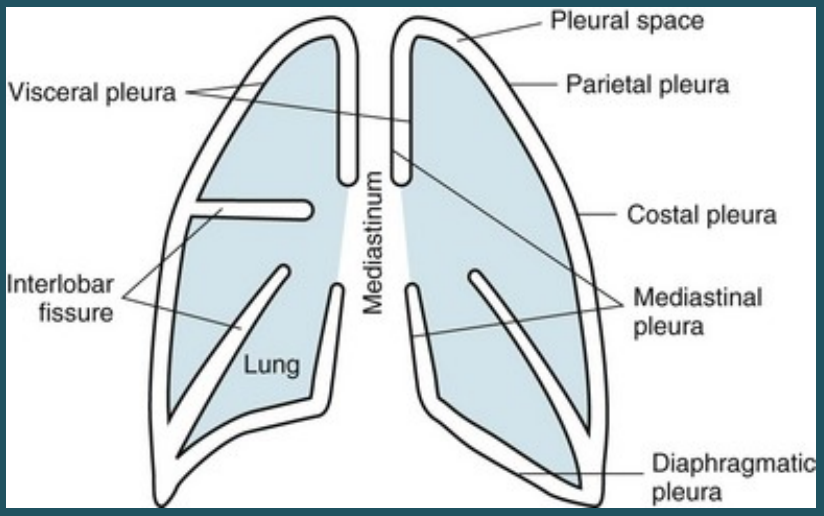


RIGHT LUNG	LEFT LUNG

• **3 lobes** – superior, middle and inferior.
• **2 fissures:** oblique & transverse fissure:
  ◦ Oblique fissure separates inferior FROM superior and middle lobes
  ◦ Horizontal fissure separates superior FROM middle lobes
• Lung hilum lies posterior to SVC and right atrium
• Right main bronchus shorter, wider and more **vertical**.
	• **2 lobes –** superior and inferior lobes.
	• **Lingula**: tongue-like extension from the lower part of the superior lobe which extends over the heart.
	• 1 fissure - oblique fissure separates the superior and inferior lobes
	• Lung hilum lies posterior to aortic arch.
	• Left main bronchus is narrower and less vertical.

Parietal & Visceral Pleura

- **Pleura definition** – single layer of **mesothelial** cells with associated connective tissue
- Parietal pleura – associated with pleural cavity.
  - Innervated by somatic nerve fibres
  - Costal pleura innervated by intercostal nerves
  - Diaphragmatic & mediastinal pleura innervated by phrenic nerve
- Visceral pleura – tightly adhered onto the surfaces of the lungs
  - Innervated by visceral afferent nerve fibres which accompany bronchial vessels.



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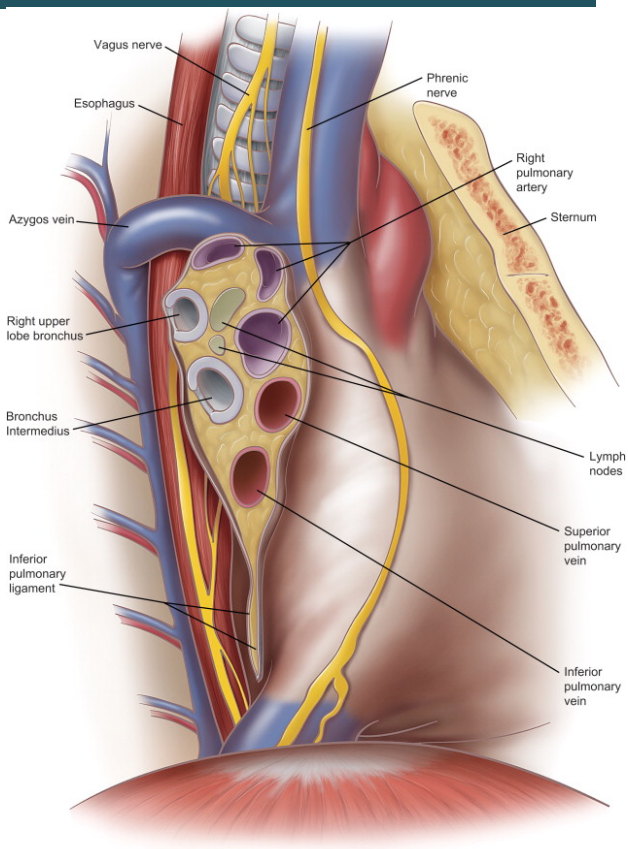
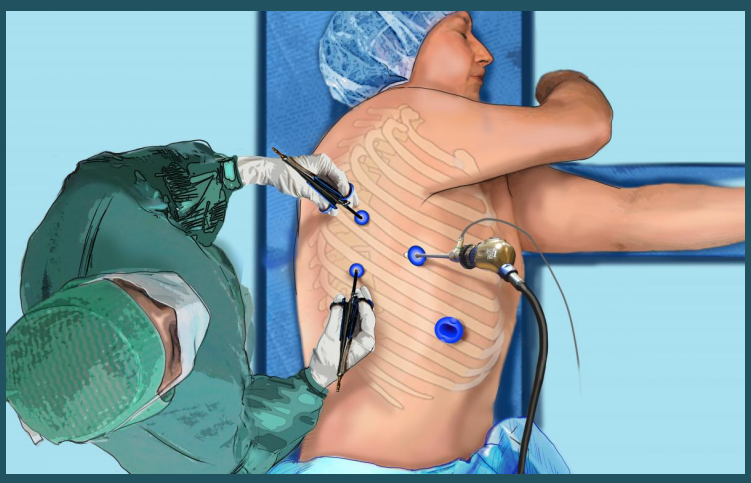
Lung Hilum

- Defined as the **pleural reflection** where structures enter & leave the lung.
- **Pulmonary ligament** is a blade-like fold of visceral pleura which extends inferiorly from the hilum to stabilize the inferior lobe & supports the movement of structures during ventilation.
- Vagus nerve extends **posterior** to lung hilum.
- Phrenic nerve extends **anterior** to lung hilum.
- **Structures passing through lung hilum**:
  - Pulmonary artery
  - 2 pulmonary veins
  - Main bronchus (left lung) and lobar bronchi (right lung)
  - Bronchial vessels
  - Lymphatics



Lobectomy Surgical Procedure

- A lobectomy involves surgical resection of a lobe of a lung, usually indicated for lung cancer e.g. early stage non-small cell lung cancer.
- This is typically performed using a **Video-Assisted Thorascopic Surgery (VATS) technique** (image on the right). This technique is a minimally invasive approach and has been shown to reduce hospital admission.
- Incisions are made through the thoracic wall to access to the lungs.
- **Surgical complications** include: prolonged air leak, pneumonia, chylothorax, empyema, infection and haemorrhage due to injury of the pulmonary artery and its branches.

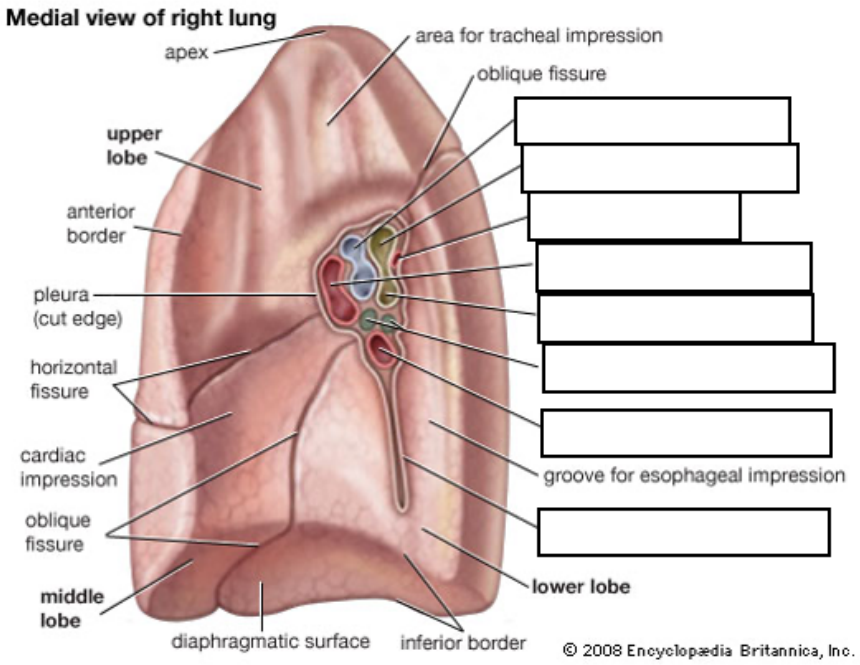


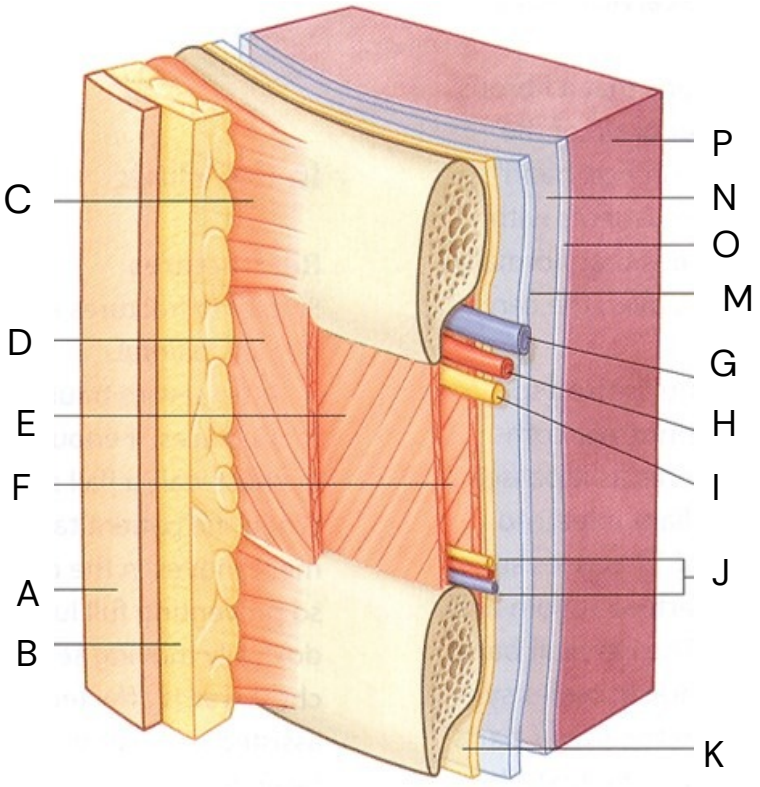
- Bronchopulmonary segments are the smallest functionally independent region of the lung and smallest area of lung that can be removed without affecting adjacent regions.
- There are typically 10 bronchopulmonary segments in each lung!

THORAX ANATOMY

Test yourself...

1) Label the structures present within the hilum of the right lung:





2) Label the layers within the intercostal space:

THORAX ANATOMY

Test yourself...

MCQ 1
A 57 year old female undergoes a left pneumonectomy for non-small cell lung cancer. As the surgeon approaches the root of the lung during the operation, which structure will lie most posteriorly in the anatomical plane?

A. Left main bronchus
B. Left phrenic nerve
C. Left bronchopulmonary lymph nodes
D. Left pulmonary artery
E. Left vagus nerve

MCQ 3
A 39-year-old male develops a spontaneous pneumothorax following a boxing match and a chest drain is inserted to drain the pneumothorax. Which of the following is a complication of chest drain insertion?

A. Pneumothorax
B. Pleural effusion
C. Pneumonia
D. Chylothroax
E. Winging of the scapula

MCQ 5
An 81-year-old male presents with haemoptysis, paraesthesia and weakness of the left forearm and hand as well as ptosis of the eye lid. What is the most likely differential diagnosis?

A. Adenocarcinoma
B. Pancoast tumour
C. Non-small cell lung cancer
D. Small cell lung cancer
E. Squamous cell carcinoma

MCQ 2
Which specific artery does the 2nd intercostal artery typically arise from?

A. Abdominal aorta
B. Subclavian artery
C. Supreme intercostal artery
D. Pericardiacophrenic artery
E. Thyrocervical trunk

MCQ 4
A stab injury to the thorax immediately right to the manubriosternal joint (sternal angle of Louis) is least likely to injure which of the following structures?

A. Trachea
B. Right phrenic nerve
C. Costal pleura
D. Right recurrent laryngeal nerve
E. Right brachiocephalic vein

MCQ 6
Which of the following statement regarding the root of the neck is false?

A. The left brachiocephalic artery crosses anterior to the aortic arch.
B. The apices of the lung pass above the first rib
C. The subclavian artery extends anterior to anterior scalene muscle.
D. The dorsal scapular artery is a branch of the subclavian artery
E. The roots of the brachial plexus is located between the anterior and middle scalenes.

THORAX ANATOMY

Test yourself...

OSCE Station - Case Based Discussion

A male patient presents to the emergency department with a suspected stab wound to the chest. The patient becomes progressively breathless and complains of pain in the anterolateral chest wall. Vital observations were: HR 120, RR 28, BP 90/59. On examination, there is reduced breath sounds on the right side of the chest with oxygen saturations of 88%. He has no significant past medical history or social history.

Q1. What would be the initial management of this patient?

Q2. What are the potential differential diagnoses from this presentation?

Q3. Which investigations will be useful in confirming a diagnosis?

Q4. How will you manage this patient?

Q5. Where would you insert a chest drain and why?

Q6. What are the potential complications of chest drain insertion?

Answers
MCQs. **1)** E, **2)** C, **3)** E, **4)** D, **5)** B, **6)** C
OSCEs: 1) A–E assessment, oxygen via non-rebreathe mask with oxygen flow rate of 15L. 2) tension pneumothorax (traumatic), others include PE, asthma/COPD, pneumonia, ACS. 3) Bloods: FBC, CRP, U&Es, d-dimer to rule out PE, arterial blood gas to quantify hypoxia; ECG to assess cardiac rhythm; chest x-ray will show lung collapse, decreased lung markings, tracheal deviation & air in pleural space. Q4) Immediate needle compression. 5) 16–18 gauge cannula or needle inserted in 2nd intercostal space, mid-clavicular line on affected side. Avoid neurovascular bundle by placing the needle above the rib. 6) Complications include organ rupture, surgical emphysema, haemothorax, misplacement, blocked tube, infection