Surgical Procedures and Surgical Approaches to Respiratory Diseases

Dr. Mohammad Al-Hurani

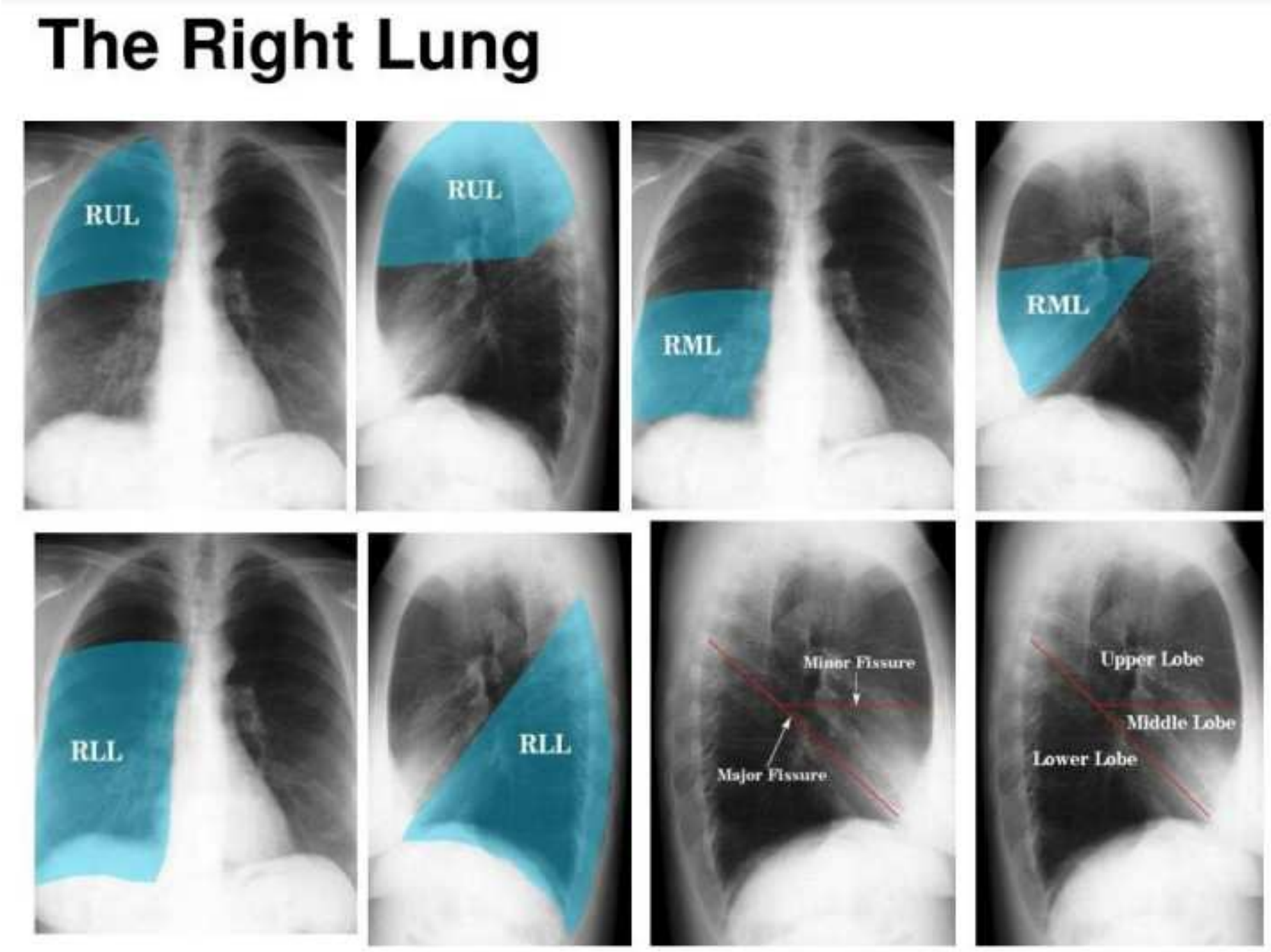
Assistant Professor of Thoracic Surgery

The Hashemite Univeristy

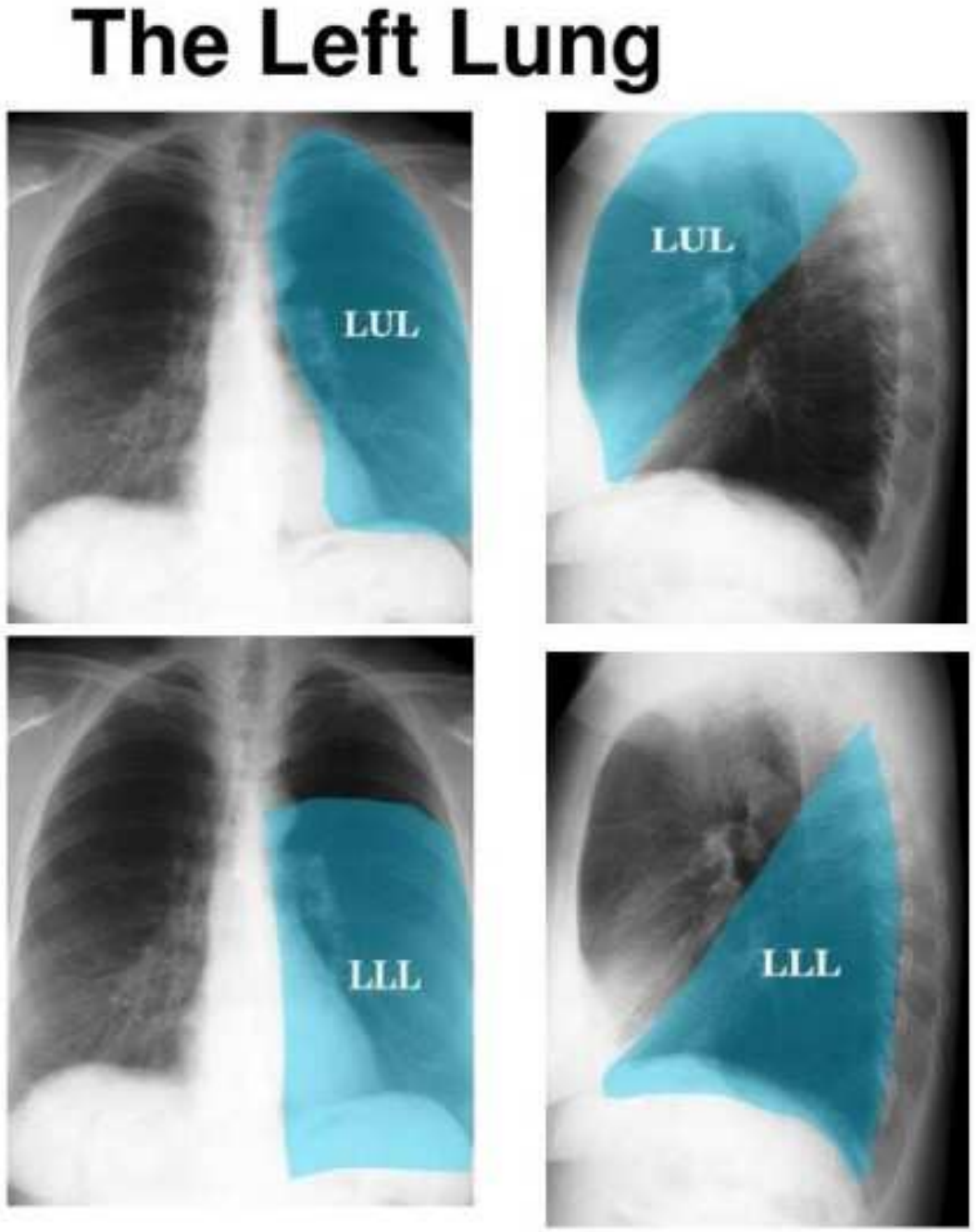
Thoracic Surgery includes:

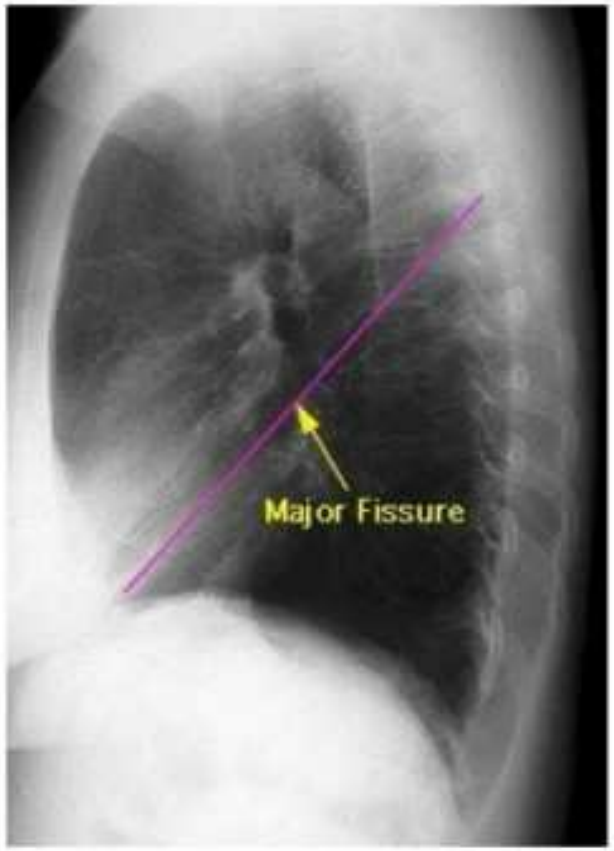
- Chest Tube Insertion
- Bronchoscopy
- Mediastinoscopy
- Video-assisted thoracoscopic surgery
- Thoracotomy

Anatomy

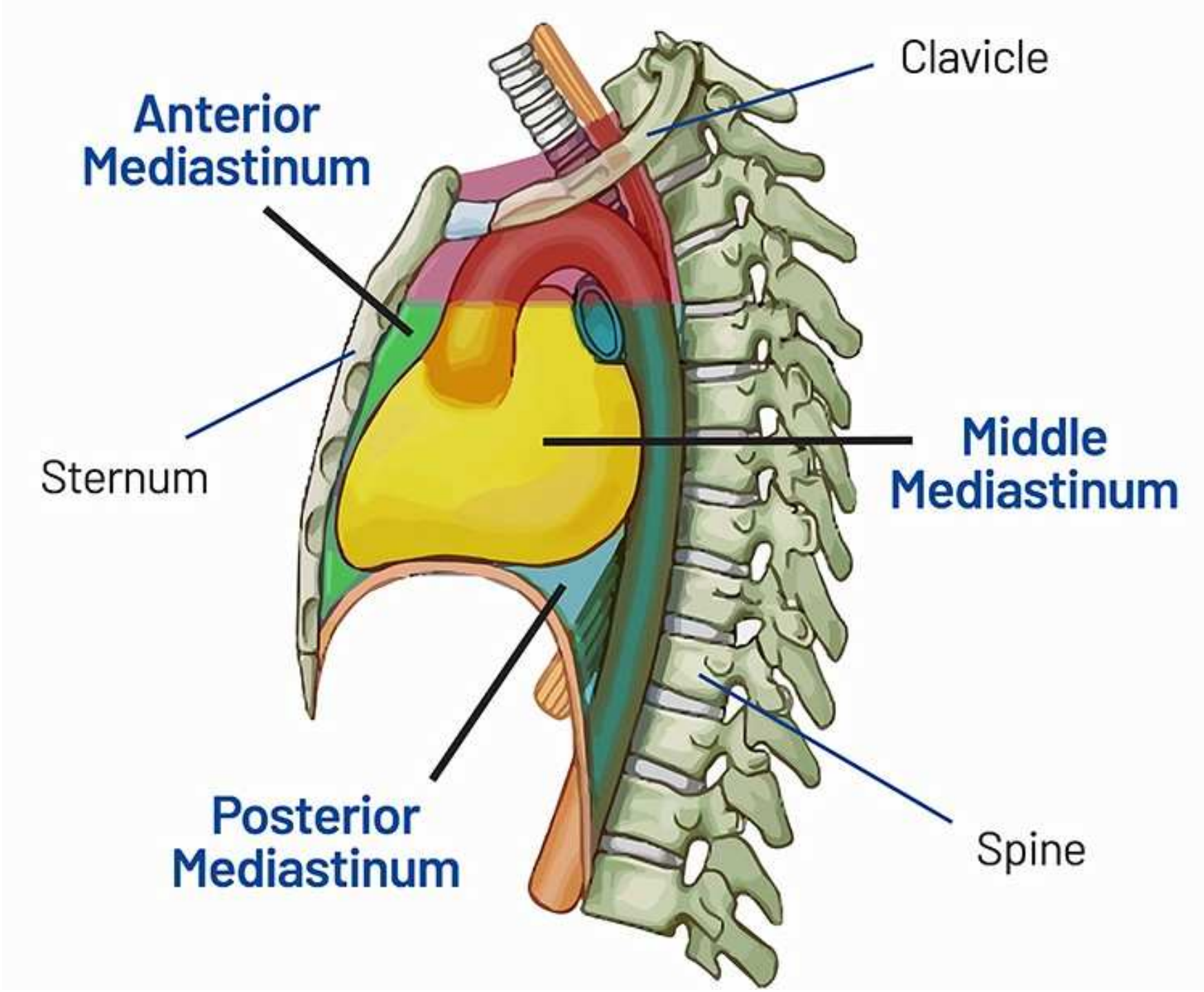

The Right Lung
RUL
RUL
RML
RML
RLL
RLL
Minor Fissure
Major Fissure
Upper Lobe
Middle Lobe
Lower Lobe

Anatomy



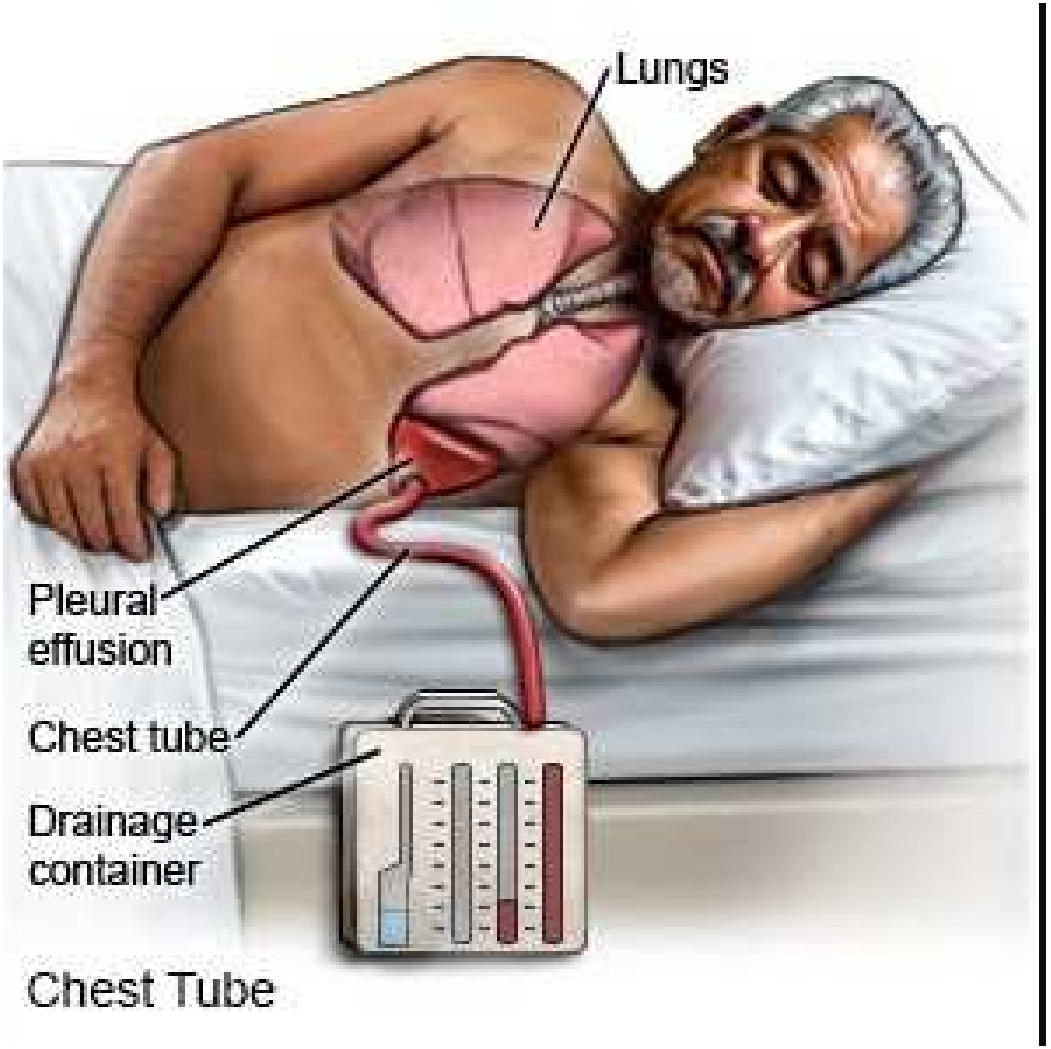


Anatomy

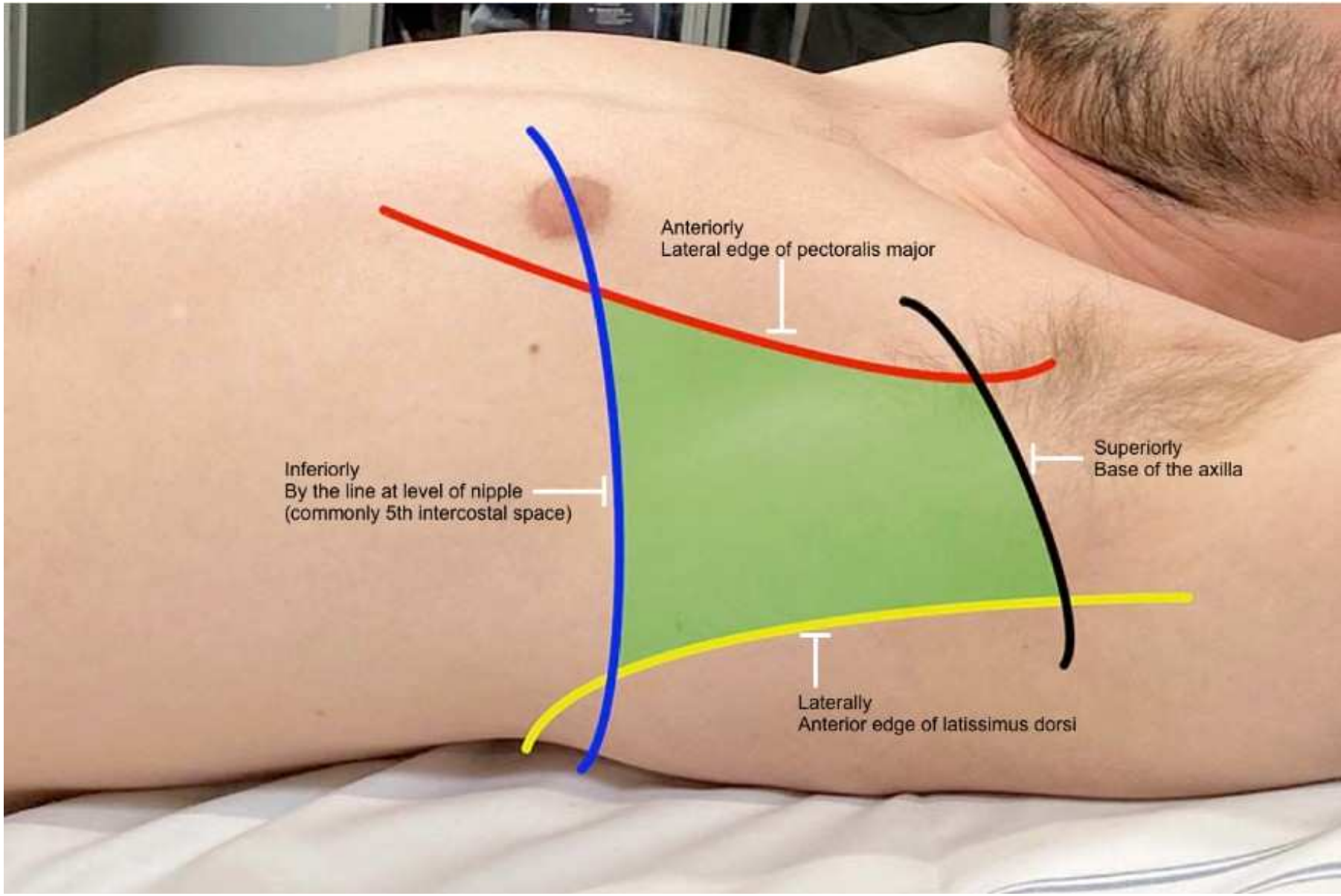

Clavicle
Anterior Mediastinum
Sternum
Middle Mediastinum
Posterior Mediastinum
Spine

Chest Tube Insertion

- definition
- Indications
  - Pneumothrax
  - Hemothorax
  - Pleural effusion
  - Post operative
- Procedure

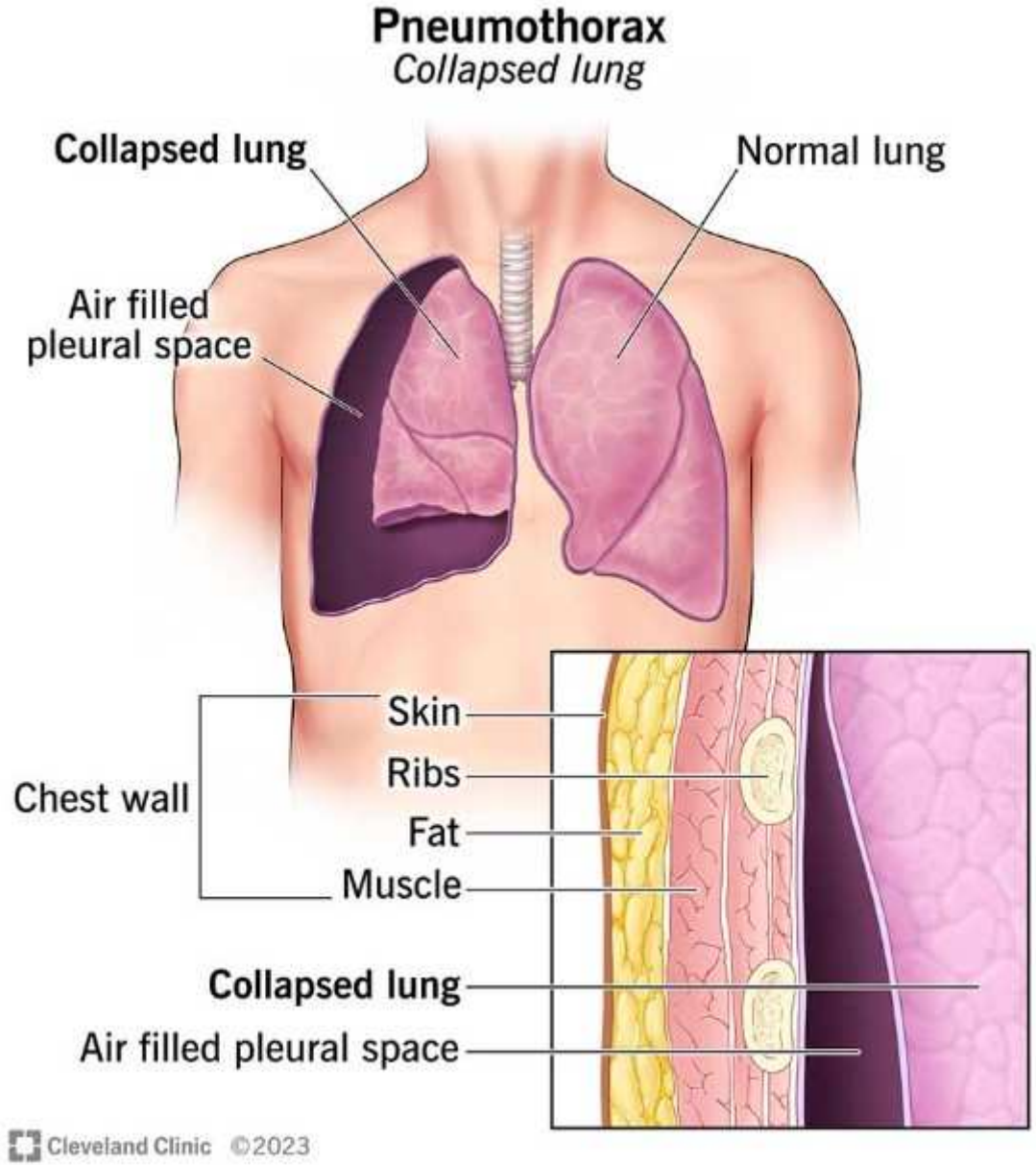


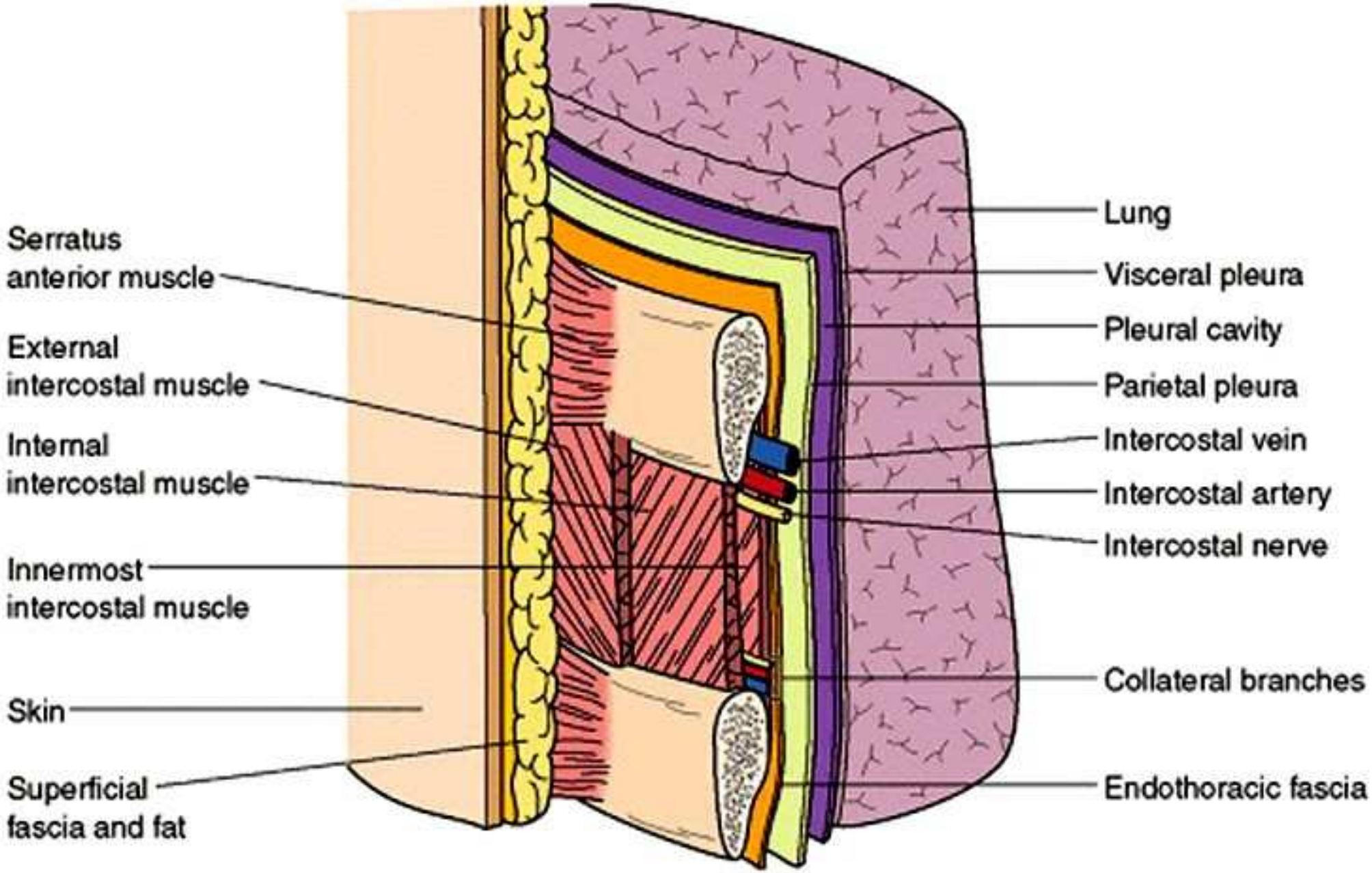
procedure


Anteriorly
Lateral edge of pectoralis major
Superiorly
Base of the axilla
Inferiorly
By the line at level of nipple
(commonly 5th intercostal space)
Laterally
Anterior edge of latissimus dorsi

Pneumothorax

- Definition
- Clinical presentation
- Classification
  - Open vs Closed
  - Simple vs Tension
  - Spontaneous vs Traumatic
- Diagnosis
- Treatment




Serratus anterior muscle
External intercostal muscle
Internal intercostal muscle
Innermost intercostal muscle
Skin
Superficial fascia and fat
Lung
Visceral pleura
Pleural cavity
Parietal pleura
Intercostal vein
Intercostal artery
Intercostal nerve
Collateral branches
Endothoracic fascia

Pleural Effusion

- Definition
- Clinical presentation
- Thoracocentesis > Chest tube insertion > 3 samples
- Types: Transudate vs Exudate
  - Lights criteria

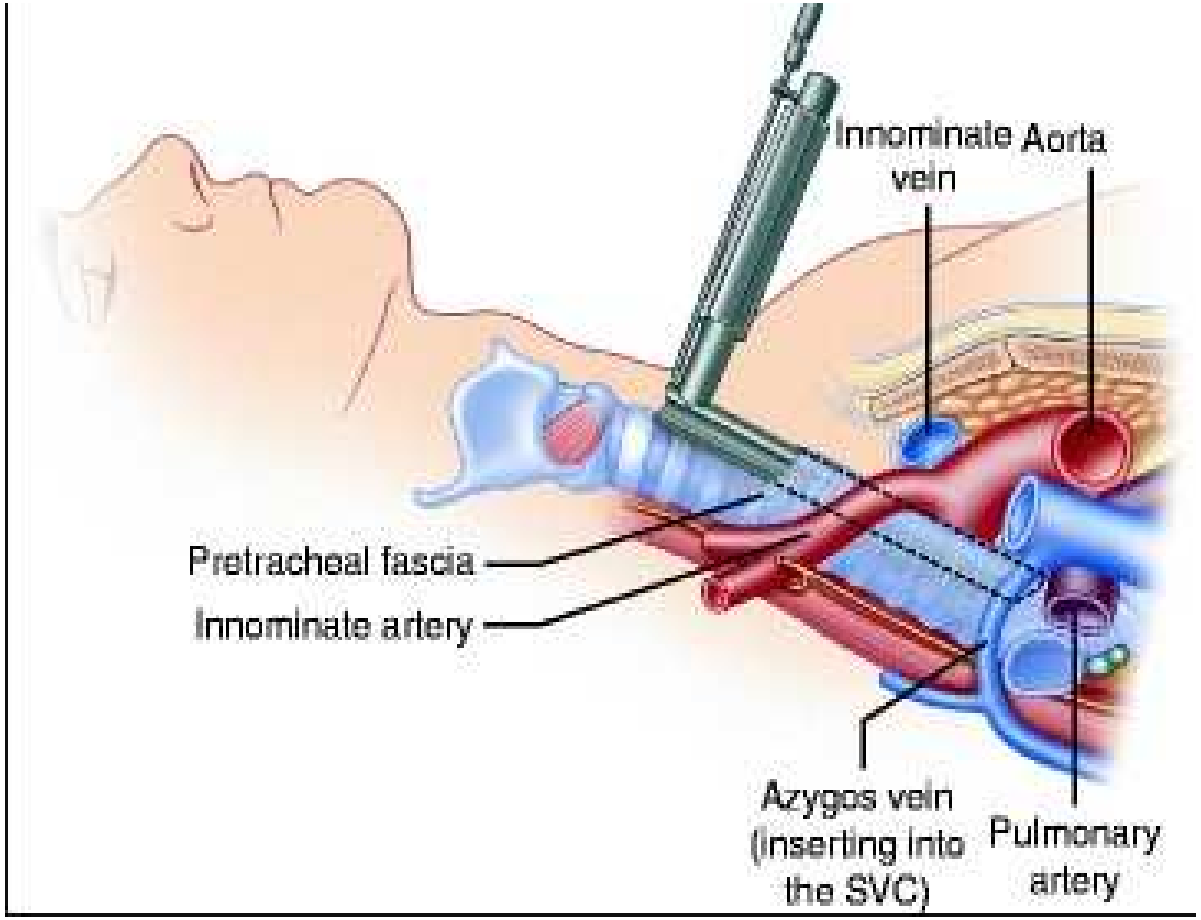
Light's Criteria

Light's criteria is a test to determine whether a pleural fluid sample is transudative (low protein) or exudative (high protein). This determination narrows down the diagnosis of etiology (causes) of pleural effusion.

CRITERIA	EXUDATE	CAUSES	TRANSUDATE	CAUSES
PLEURAL SERUM PROTEIN	>/= 0.5	• malignancy • bacterial/viral pneumonia • tuberculosis • pulmonary embolism • pancreatitis • esophageal rupture • collagen vascular disease • chylothorax • hemothorax	<0.5	• heart failure • cirrhosis • nephrotic syndrome • pulmonary embolism
PLEURAL SERUM LDH	>/= 0.6		<0.6	
PLEAURAL FLUID LDH	> 2/3 upper limit of normal		< 2/3 upper limit of normal	

Mediastinoscopy

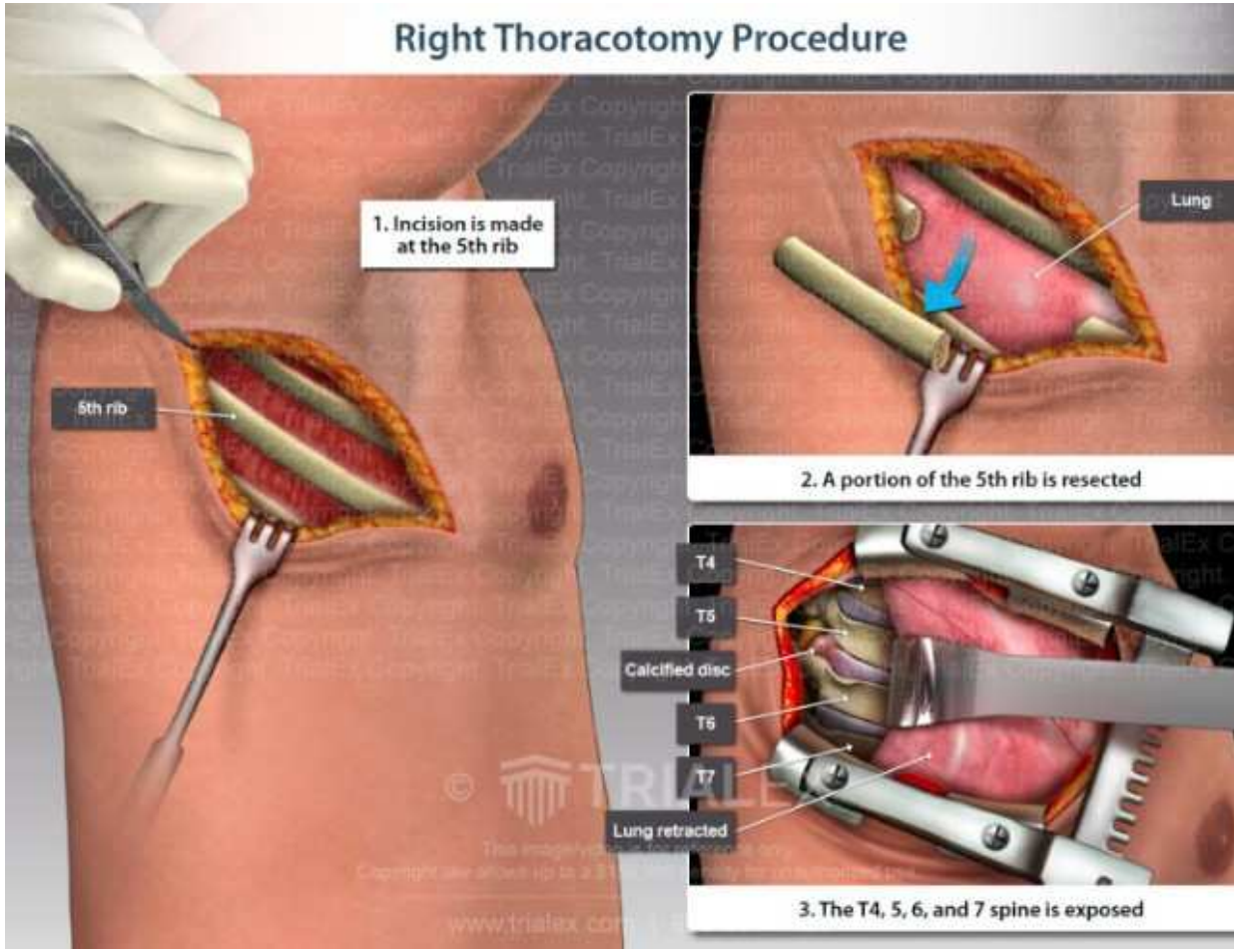
- Indication:
  - Diagnostic
  - Staging



Video-Assisted Thoracoscopic Surgery (VATS)

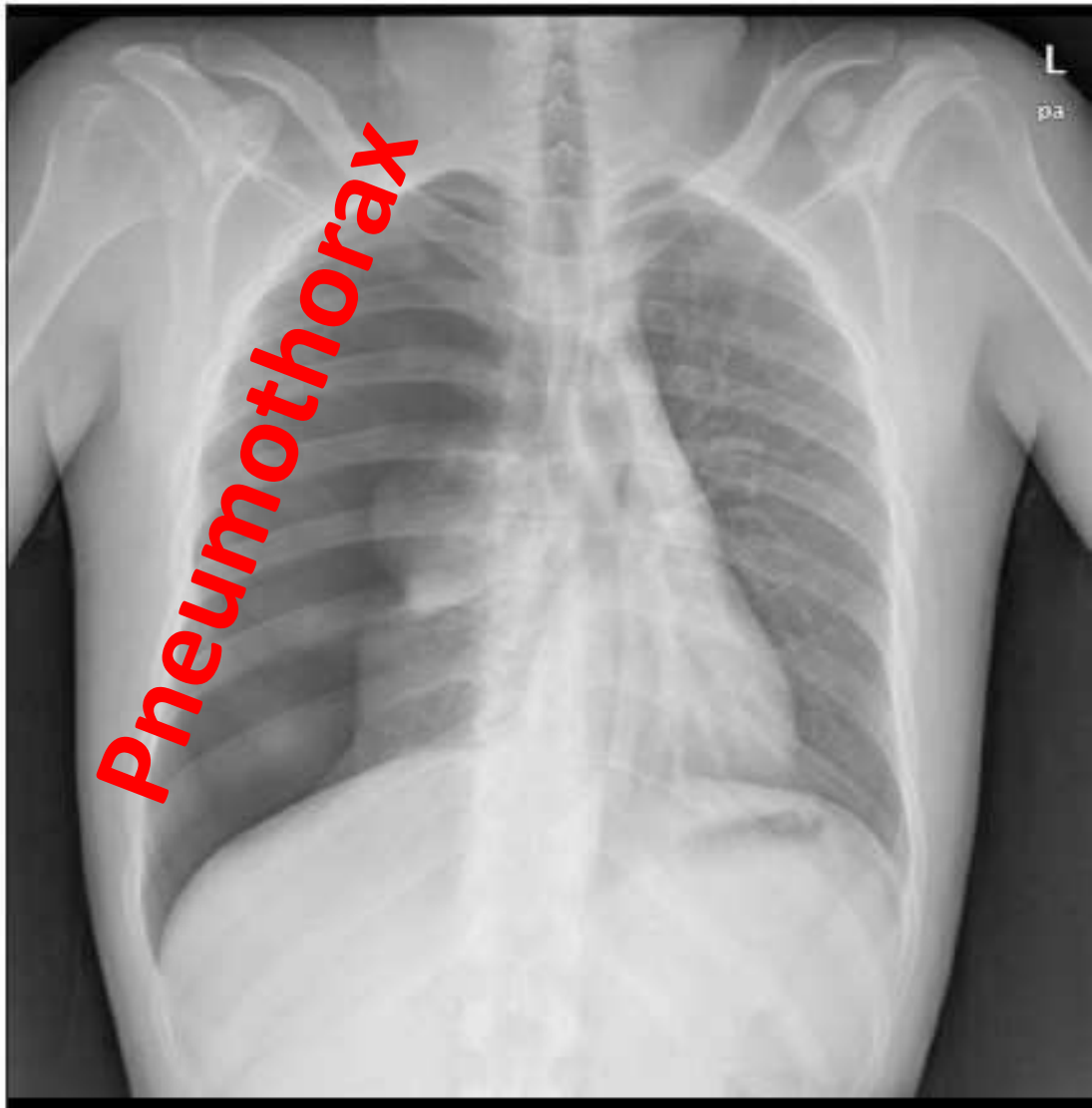
- Minimal Invasive
- Less pain
- Less hospitalization

Thoracotomy



Case 1

- 24-year-old male patient presented to the Emergency department complaining of right sided pleuritic chest pain of acute onset associated with Shortness of breath. O/E there is decreased breathing sounds on right side. His vital signs were within normal ranges except for tachypnea and oxygen saturation 89%.



Case 1

- 24-year-old male patient presented to the Emergency department complaining of right sided pleuritic chest pain on acute onset associated with Shortness of breath. O/E there is decreased breathing sounds on right side. His vital signs were within normal ranges except for tachypnea and oxygen saturation 89%.

Case 1

- Same patient, Active air leak after 7 days
  - What is the next step ?

Surgery

Indications of Surgery

- Recurrent Pneumothorax
- Prolonged air leak (> 5-7 days)
- High risk jobs (pilot, divers)

Fig. 2 Clinical photograph shows our patient with (a) extensive subcutaneous emphysema causing closure of palpebral fissure;

Case 2

- 54-year-old female patient presented to the ED complaining of shortness of breath of 2 weeks duration associated with productive cough and fever. X-ray chest is shown.

- What is next ?

Pleural fluid sampling

- Cytology
- microbiology
- Biochemistry
  - PH
  - Glucose
  - Protein
  - LDH

Physiological Pleural Fluid

- **Pleural Fluid is clear ultrafiltrate of plasma, and composed of:**
  - **Cellular elements:**
    - **No RBC**
    - **WBC < 1000/mm3**
  - **Protein, Glucose, Ions, and Enzymes:**
    - **PH= 7.6 – 7.64**
    - **Protein: 10-20 g/L**
    - **Glucose level = Serum Level**
    - **LDH < 50% of Serum**

Transudative effusion: is the result of increased formation or decreased absorption of pleural fluid caused by changes in the Starling forces.

Exudative effusion : results from inflammatory or malignant alterations or diseases of the pleura itself. If analysis shows at least **ONE** of the following according to light's criteria:

- **Pleural fluid protein/serum protein > 0.5**
- **Pleural fluid LDH/serum LDH > 0.6**
- **Pleural fluid LDH >2/3 of the upper limit of normal for the serum LDH.**

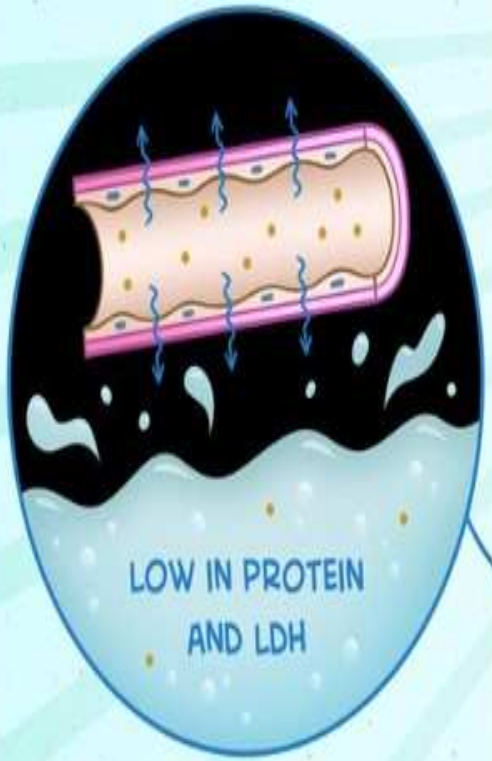
PLEURAL EFFUSION

ACCUMULATION OF FLUID WITHIN THE PLEURAL SPACE

TRANSUDATIVE

OCCURS DUE TO INCREASED HYDROSTATIC PRESSURE OR LOW PLASMA ONCOTIC PRESSURE

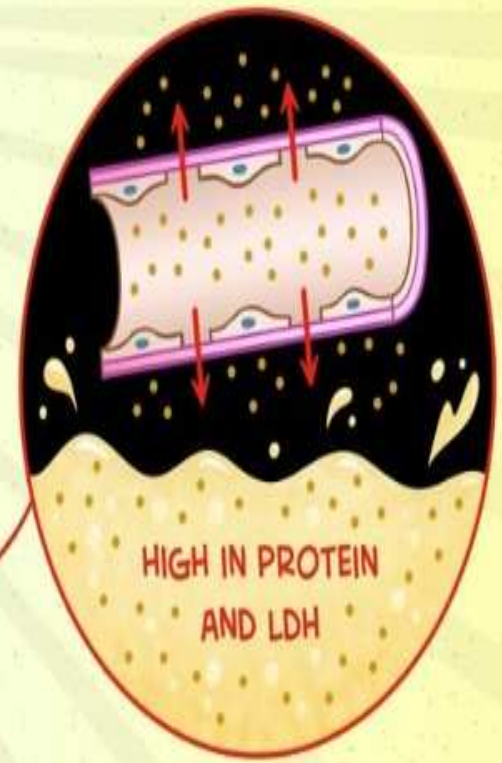
E.G., CHF, CIRRHOSIS, NEPHROTIC SYNDROME, PE, HYPOALBUMINEMIA

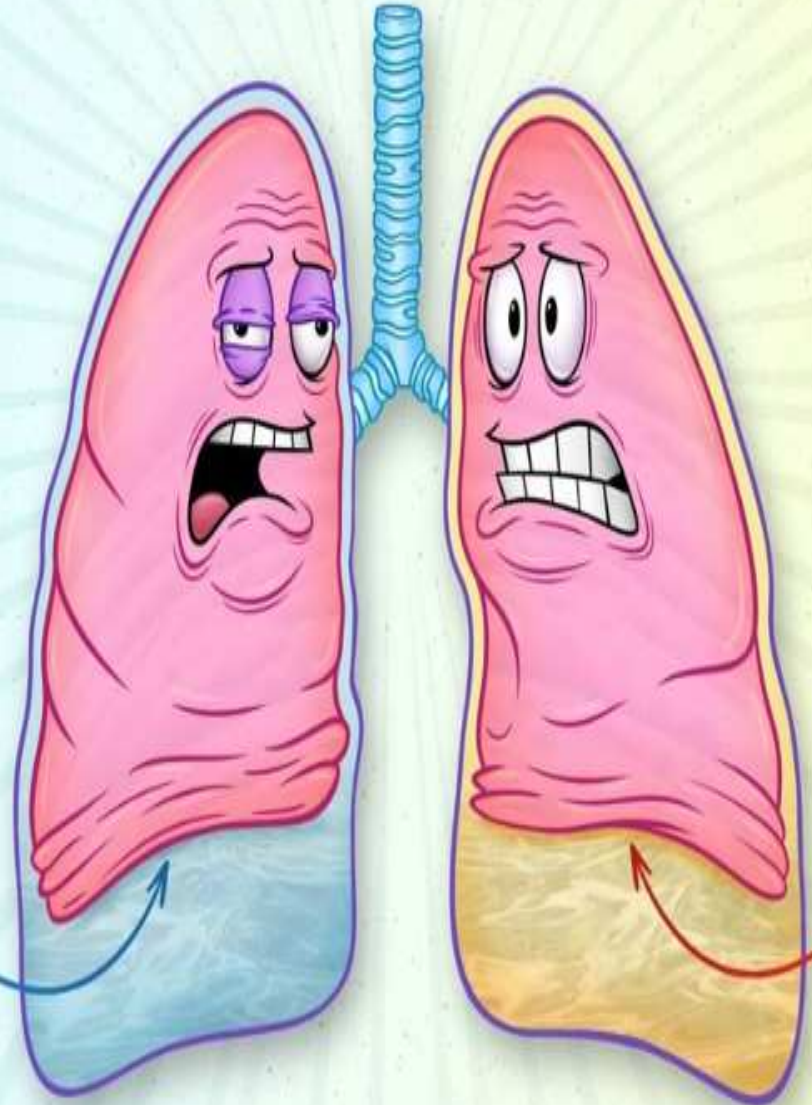


EXUDATIVE

OCCURS DUE TO INFLAMMATION AND INCREASED CAPILLARY PERMEABILITY

E.G., PNEUMONIA, CANCER, TB, VIRAL INFECTION, PE, AUTOIMMUNE





Transudate

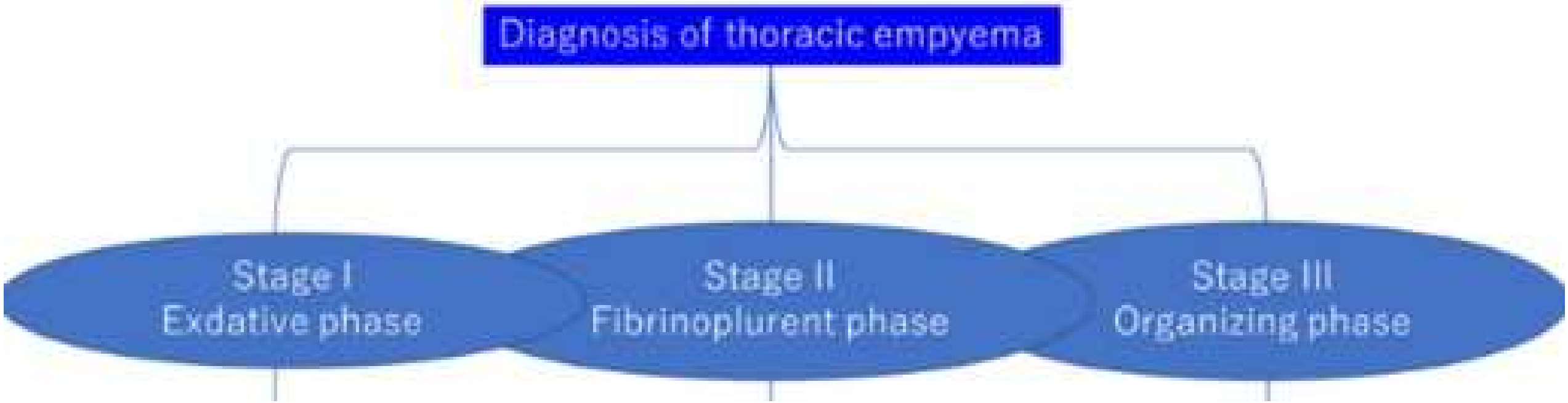
- LV Failure
- Cirrhosis
- Hypoalbuminemia
- Atelectasis
- Renal Failure
- Peritoneal Dialysis
- PE (10-20%)
- CA (5%)
- MV disease
- Constrictive pericarditis
- Meigs' syndrome

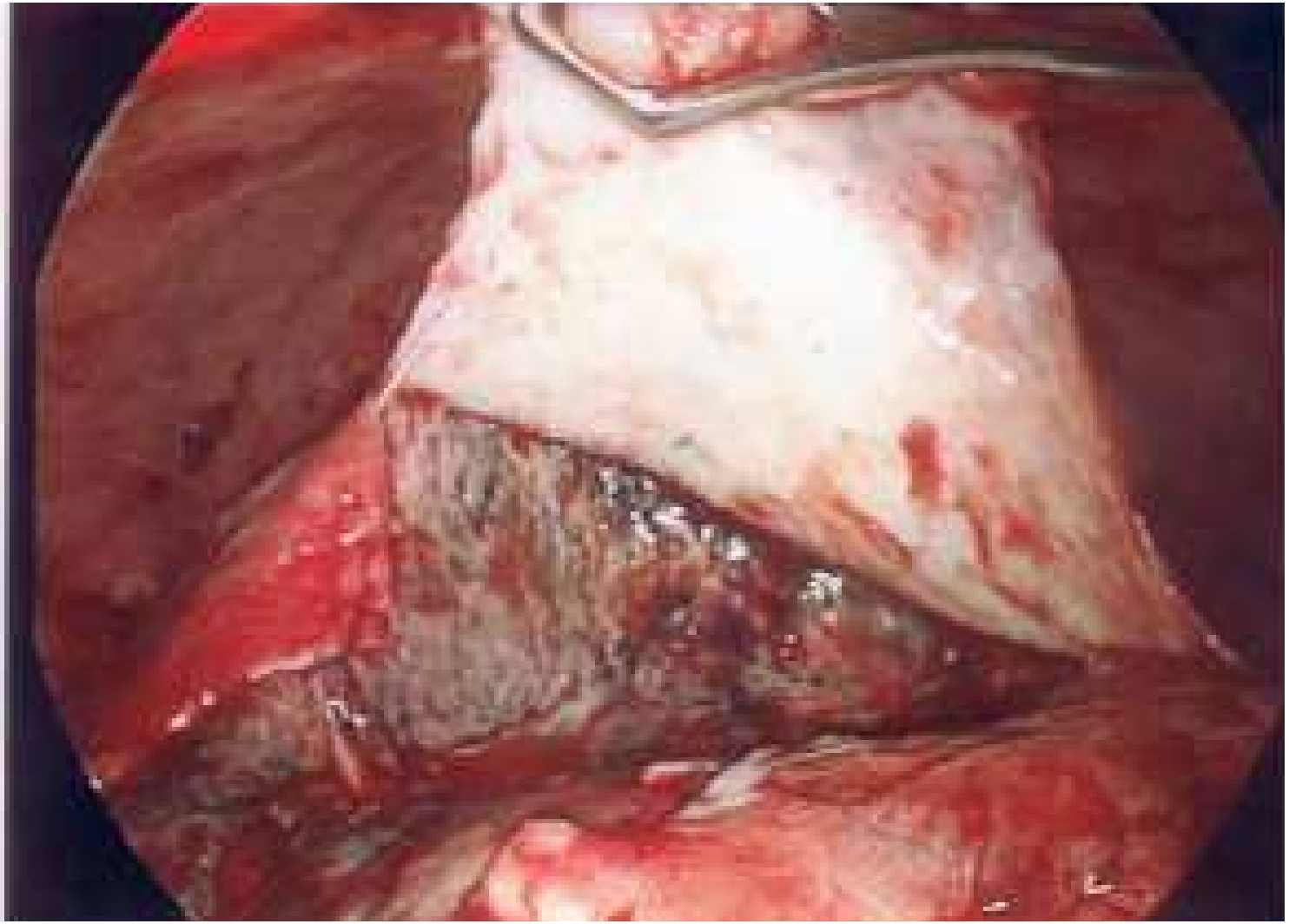
Exudate

- CA (95% of CA cases)
- Parapneumonic effusion
- TB
- SLE
- R. Arthritis
- Pancreatitis
- Esophageal Rupture
- Chylothorax
- Drugs (Amiodarone, phenytoin, methotrexate

Case 2

- Empyema
  - Definition
  - Stages
  - Treatment
    - Goals of the treatment

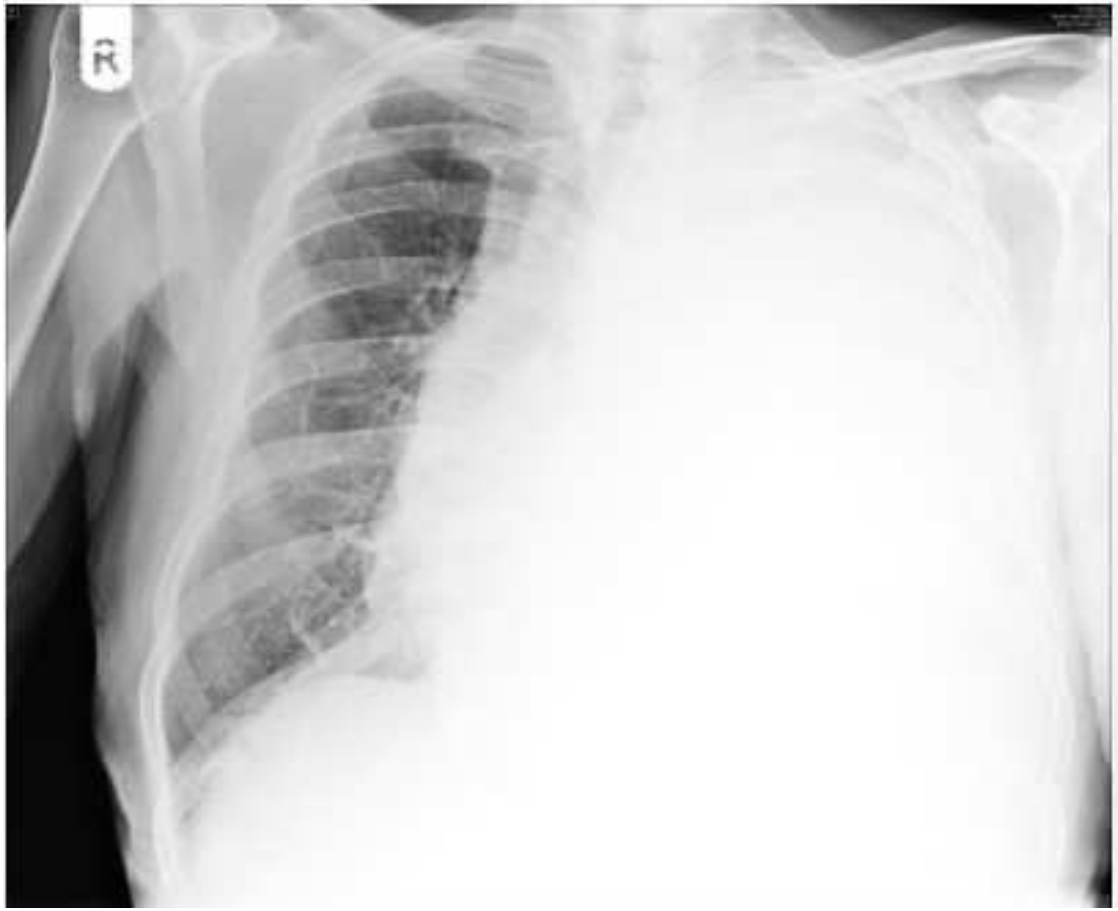

Diagnosis of thoracic empyema
Stage I
Exdative phase
Stage II
Fibrinoplurent phase
Stage III
Organizing phase



Case 3

- 23- year-old male patient presented to ED as a victim of Road traffic accident. After completing the primary survey, the patient was complaining of shortness of breath and tenderness over the left chest wall. X-ray chest was performed

What is your next step ?



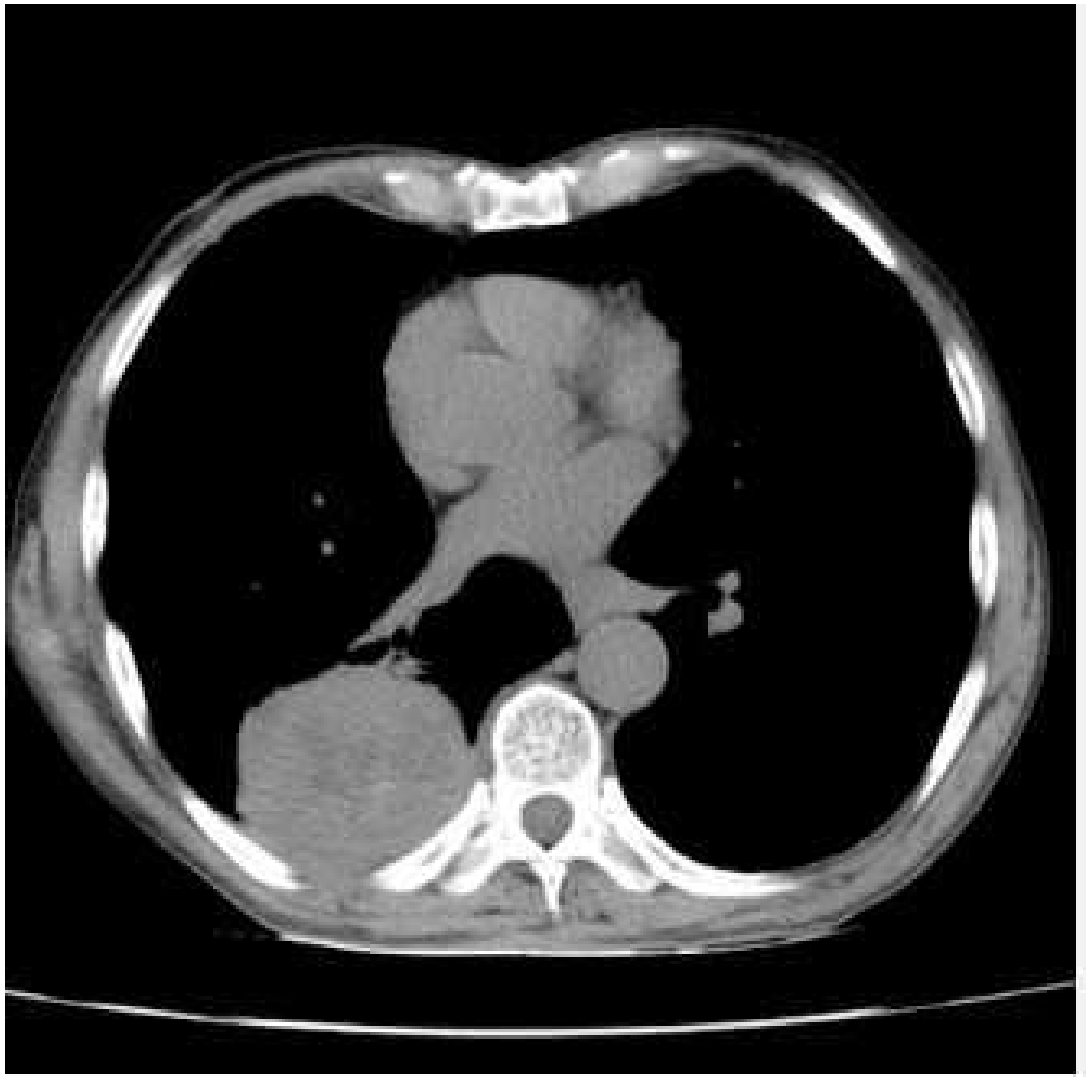
- On insertion of chest tube, 1500 cc blood came out!

What is your next step ?

Emergency Thoracotomy

Case 4

- 60-year-old male patient, smoker, incidentally, found to have a lung mass on CT scan.



What is your next step ?

Clinical Staging

Hematological and functional investigation

- CBC
- KFT, LFT, Electrolytes
- PFT (FEV1, VC)
- Diffusion DLCO
- Cardio-pulmonary exercise test.
- Perfusion ventilation scan

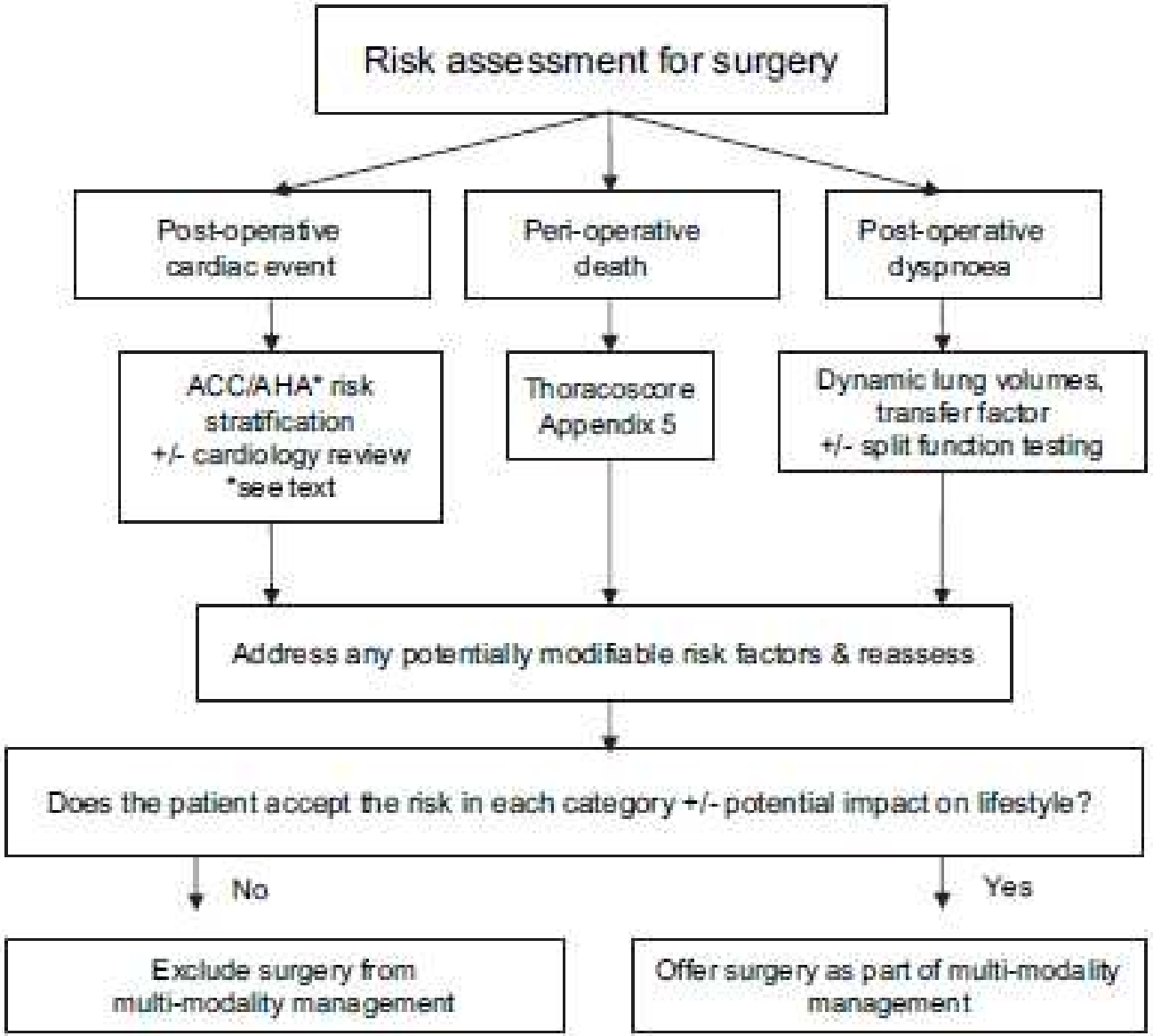


Figure 2 Tripartite risk assessment. ACC, American College of Cardiology; AHA, American Heart Association.

Radiological Evaluation

- CXR
- CT
- PET-CT
- PET

8th TNM staging system

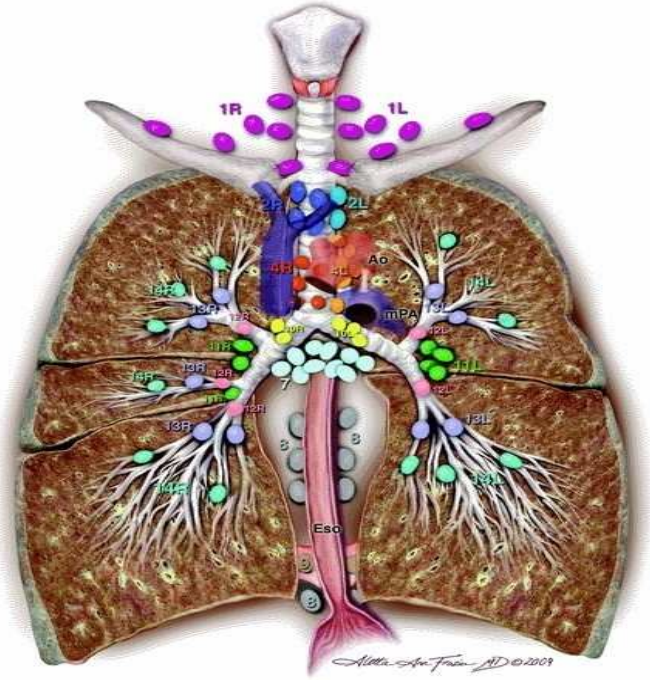
- Invasive vs non-invasive
- Invasive
  - Bronchoscopy and Biopsy
  - Video-Mediastinoscopy
  - Endobronchial US and Biopsy (EBUS)
  - Endo-esophageal US and Biopsy (EUS)
  - Anterior mediastinoscopy
  - Video-assisted thoracoscopy
  - Transthoracic CT-guided biopsy

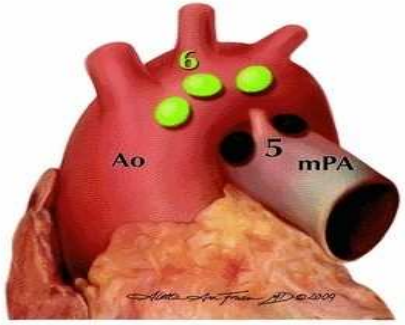
Primary Tumor (T)

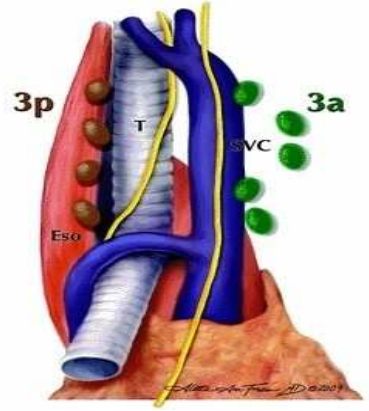
T classification		T components on CT	
Tis (AIS)		Pure GGN ≤ 3 cm	
T1	T1mi	≤ 0.5 cm solid part within part-solid tumor total size ≤3 cm	
	T1a	0.6–1.0 cm solid part within part-solid tumor total size ≤3 cm	
		Pure GGN >3 cm	
		≤ 1 cm solid tumor	
	T1b	1.1–2.0 cm solid part within part-solid tumor total size ≤3 cm	
		>1–2 cm solid tumor	
	T1c	2.1–3 cm solid part within part-solid tumor total size ≤3 cm	
		>2–3 cm solid tumor	
T2	T2a	3.1–4 cm	Involves main bronchus without involvement of carina
	T2b	4.1–5 cm	Total/partial atelectasis
			Total/partial pneumonitis
			Involves hilar fat
			Involves visceral pleura (PL1 or PL2)
T3		5.1–7 cm	Separate tumor nodules in the same lobe as the primary
			Involves parietal pleura (PL3)
			Parietal pericardium
			Chest wall
			Phrenic nerve
T4		>7 cm	Involves diaphragm
			Mediastinal fat or other mediastinal structures (trachea, great vessels, heart, recurrent laryngeal nerve, esophagus)
			Carina
			Vertebral body
			Visceral pericardium
			Separate tumor nodules in the same lung but different lobes as the primary

Nodal Status (N)

N classification	N component on CT
N0	No lymph node metastasis
N1	Ipsilateral peripheral, intrapulmonary or hilar nodes metastasis
N2	Ipsilateral mediastinal (upper, aortico-pulmonary, lower), subcarinal nodes metastasis
N3	Ipsilateral or contralateral supraclavicular/scalene lymph node or contralateral mediastinal, hilar/interlobar, or peripheral nodes metastasis







Supraclavicular zone

1 Low cervical, supraclavicular, and sternal notch nodes

SUPERIOR MEDIASTINAL NODES

Upper zone

- 2R Upper Paratracheal (right)
- 2L Upper Paratracheal (left)
- 3a Prevascular
- 3p Retrotracheal
- 4R Lower Paratracheal (right)
- 4L Lower Paratracheal (left)

AORTIC NODES

AP zone

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

INFERIOR MEDIASTINAL NODES

Subcarinal zone

- 7 Subcarinal

Lower zone

- 8 Paraesophageal (below carina)
- 9 Pulmonary ligament

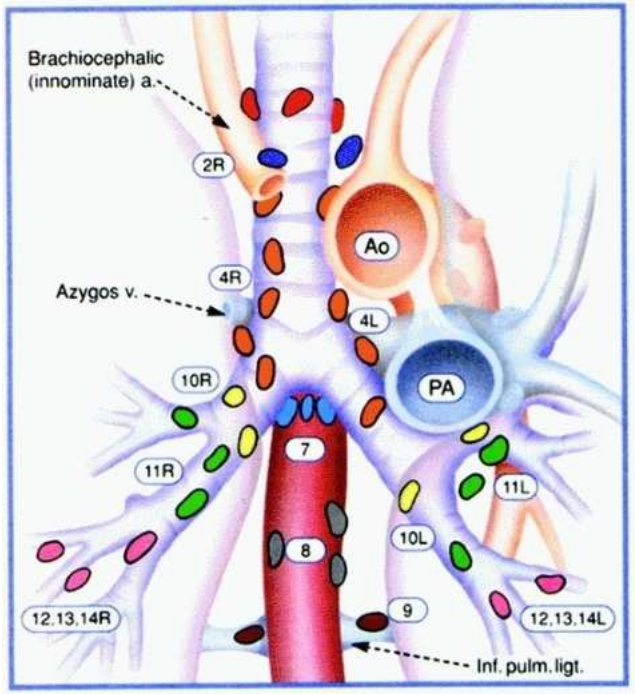
N1 NODES

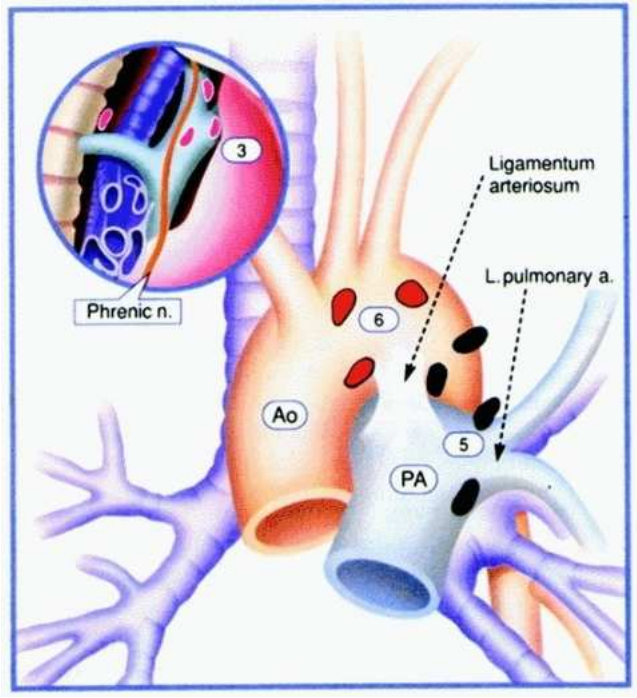
Hilar/Interlobar zone

- 10 Hilar
- 11 Interlobar

Peripheral zone

- 12 Lobar
- 13 Segmental
- 14 Subsegmental





Superior Mediastinal Nodes

- **1** Highest Mediastinal
- **2** Upper Paratracheal
- **3** Pre-vascular and Retrotracheal
- **4** Lower Paratracheal (including Azygos Nodes)

N_2 = single digit, ipsilateral
N_3 = single digit, contralateral or supraclavicular

Aortic Nodes

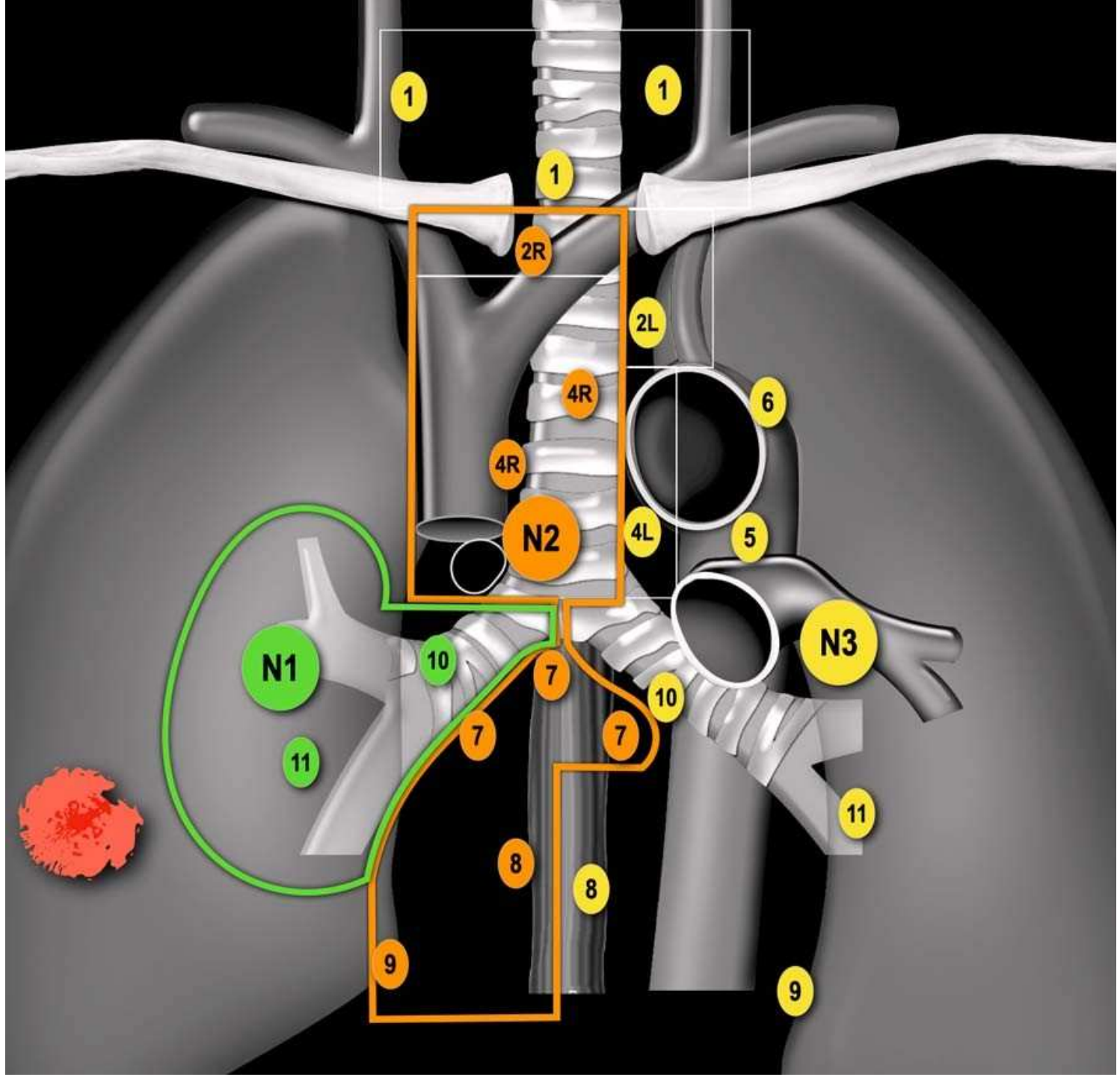
- **5** Subaortic (A-P window)
- **6** Para-aortic (ascending aorta or phrenic)

Inferior Mediastinal Nodes

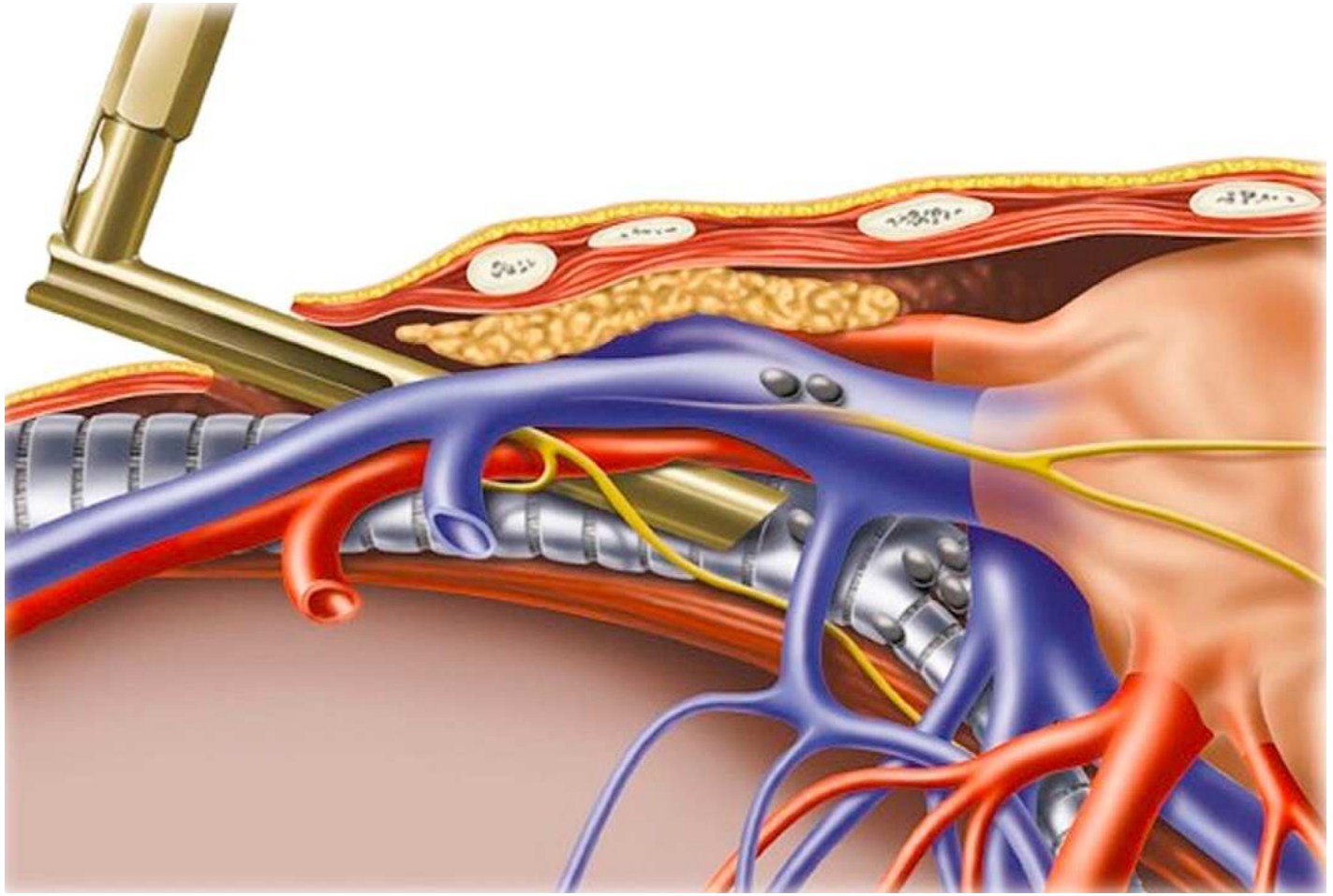
- **7** Subcarinal
- **8** Paraesophageal (below carina)
- **9** Pulmonary Ligament

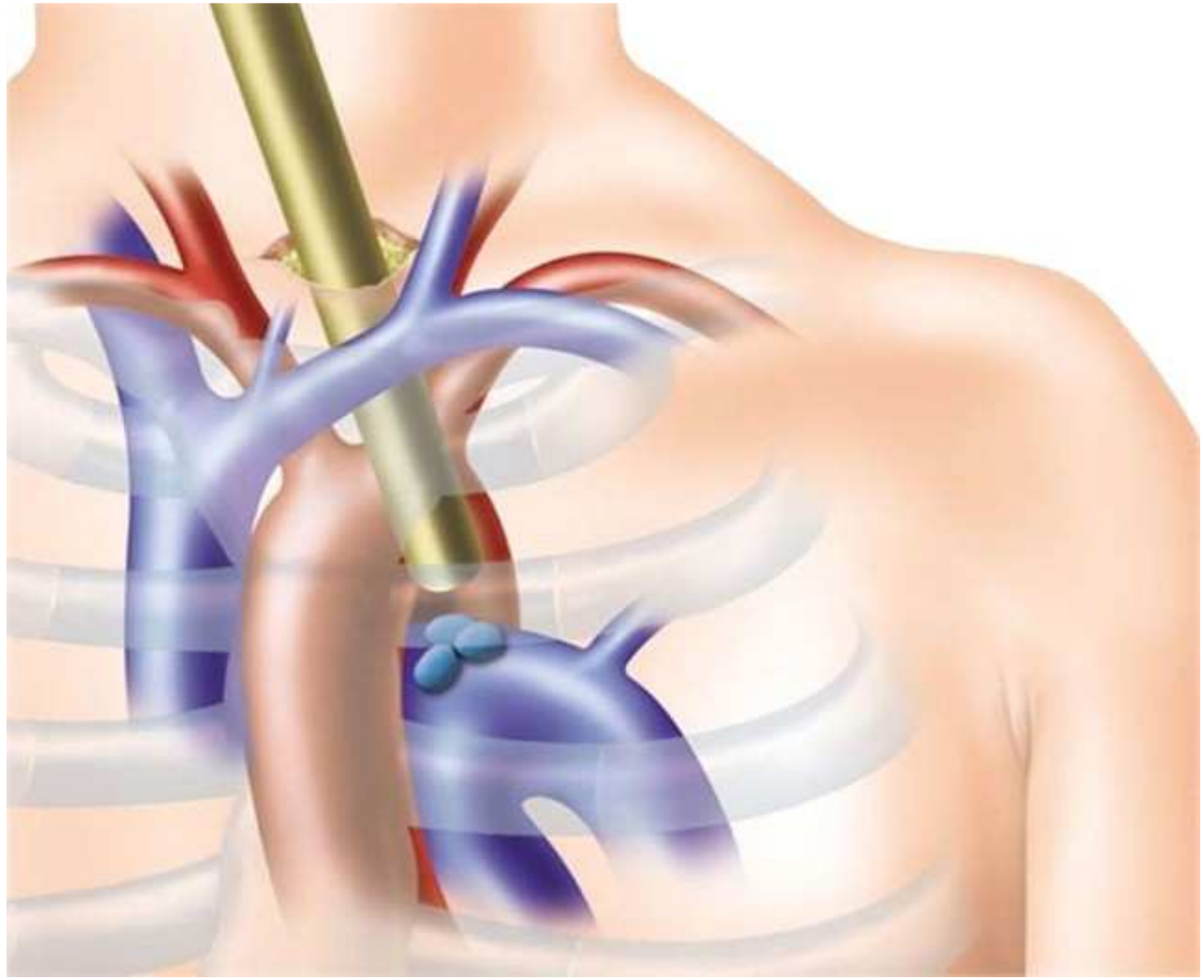
N_1 Nodes

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


1
1
1
2R
2L
4R
6
4R
N2
4L
5
N1
10
7
N3
10
7
7
11
11
8
8
9
9

Video-Mediastinoscopy





Thoracic Surgery Clinics 2010; 20:195-206

Distant Metastasis (M)

M classification		M component on CT
M0		No distal metastasis
M1	M1a	Intrathoracic metastasis
		Pleural effusion
		Pericardial effusion
		Contralateral lung nodules/pleural nodules
	M1b	Single extrathoracic metastasis in a single organ
	M1c	Multiple extrathoracic metastasis

8th TNM staging system

		N0	N1	N2	N3
M0	Tis	0			
	T1mi	IA1			
	T1a	IA1	IIB	IIIA	IIIB
	T1b	IA2	IIB	IIIA	IIIB
	T1c	IA3	IIB	IIIA	IIIB
	T2a	IB	IIB	IIIA	IIIB
	T2b	IIA	IIB	IIIA	IIIB
	T3	IIB	IIIA	IIIB	IIIC
	T4	IIIA	IIIA	IIIB	IIIC
M1a	Tx	IVA	IVA	IVA	IVA
M1b	Tx	IVA	IVA	IVA	IVA
M1c	Tx	IVB	IVB	IVB	IVB

Thank You