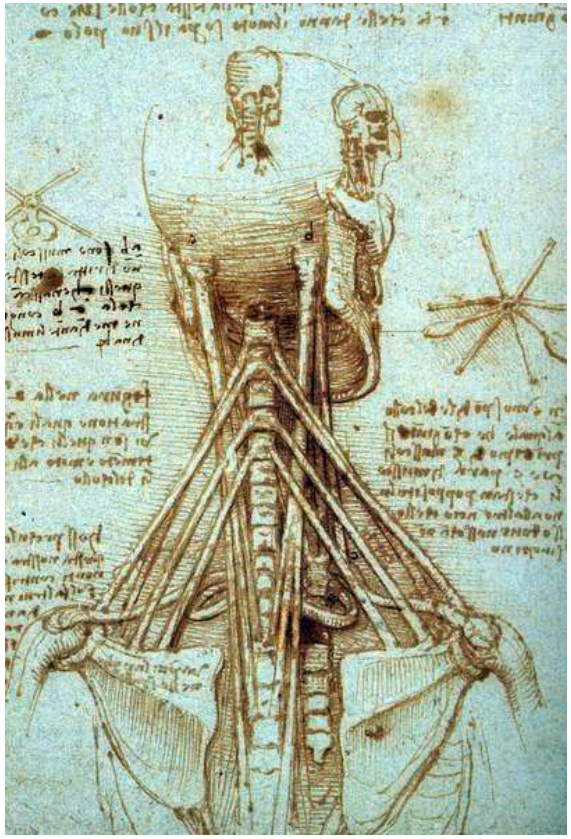
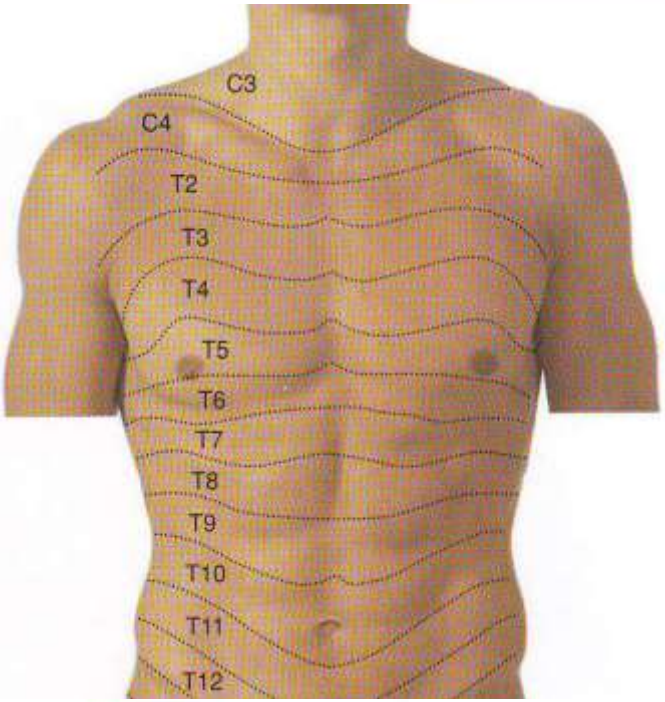


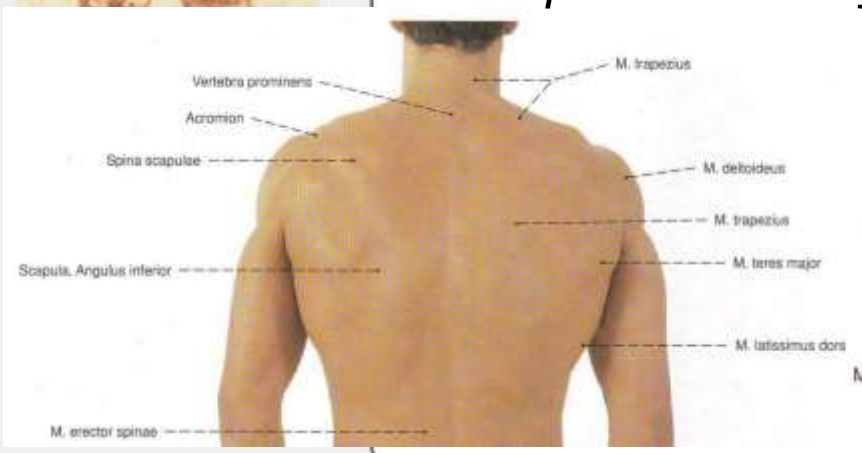
Topographic anatomy of the thorax

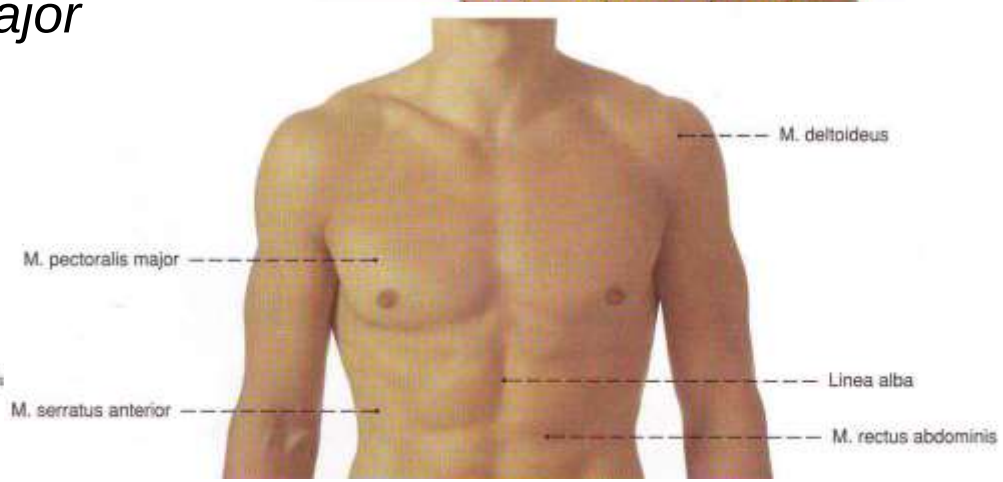
1. Thorax – boundaries, palpation points, and regions
2. Presternal and infraclavicular regions
3. Pectoral region – *regio mammaria* and *regio inframammaria*
4. Axillary region
5. Thoracic wall
6. Thoracic cavity:
   - ✓ mediastinum – heart, great vessels and pericardium
   - ✓ diaphragm
7. Viscera of the thoracic cavity:
   - ✓ lungs and pleurae

Boundaries and palpation points

- *incisura jugularis sterni*
- *punctum suprasternale* – superior border of *manubrium sterni*
- *angulus sterni* – Th4
- *processus xiphoideus sterni*
- lowest point on costal arch – Xth rib/L3
- *m. pectoralis major*

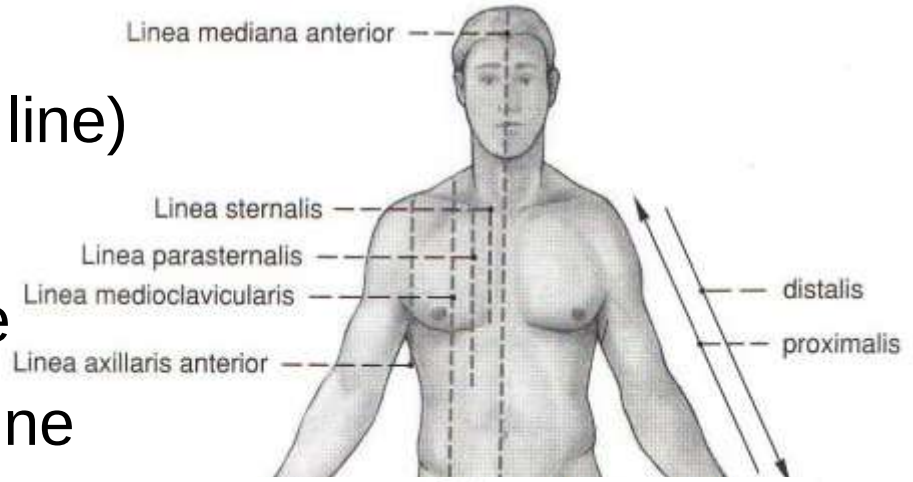


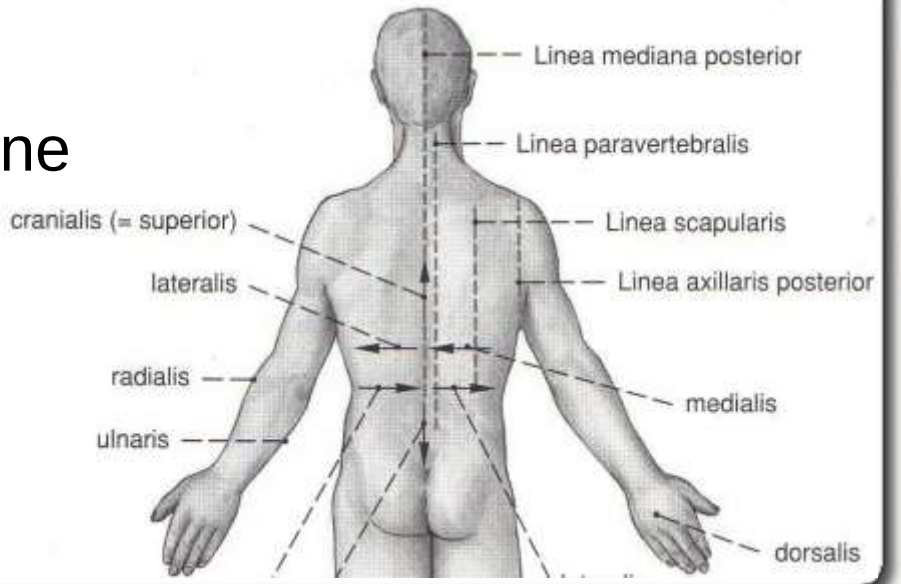




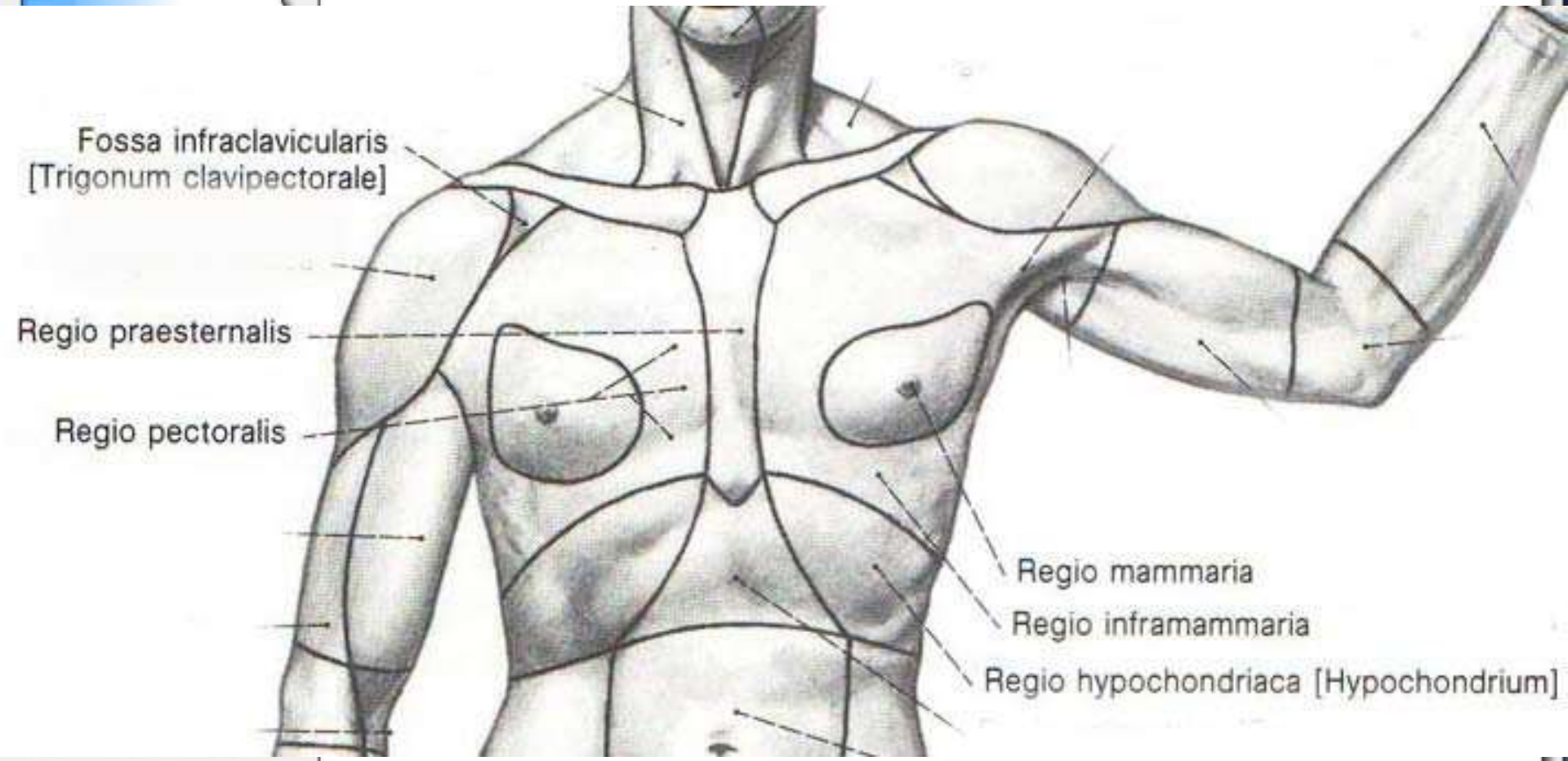
Topographic lines

- (mid)sternal line (anterior median line)
- parasternal line
- midclavicular line
- anterior axillary line
- midaxillary line
- posterior axillary line
- scapular line
- paravertebral line
- posterior median (midvertebral) line



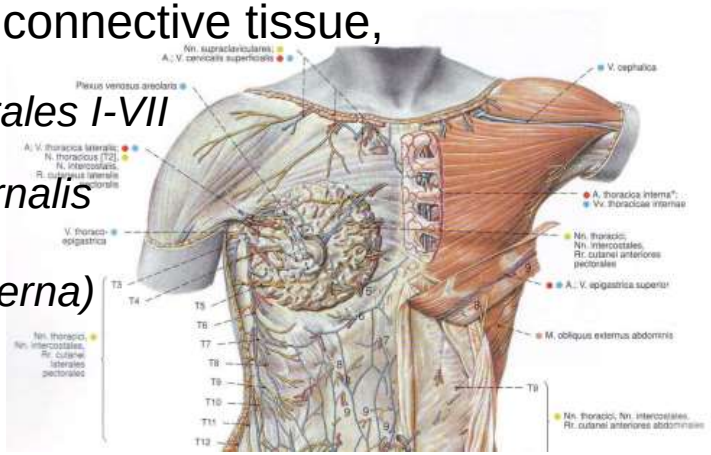


Topographic regions



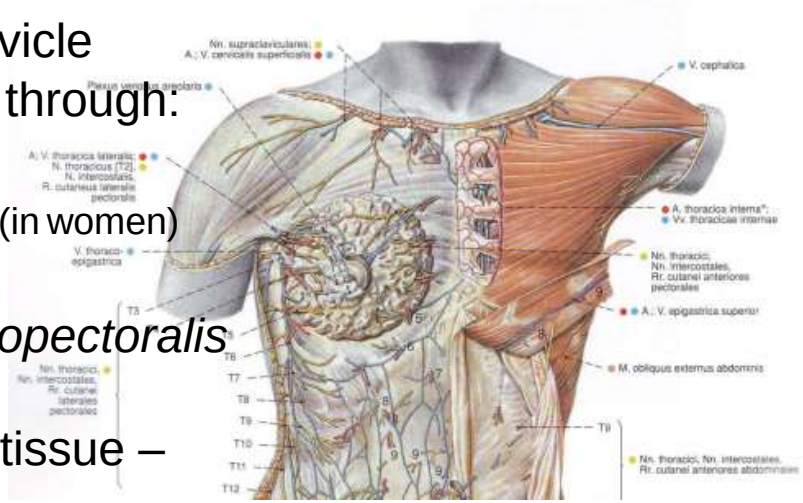
Presternal region, *Regio presternalis*

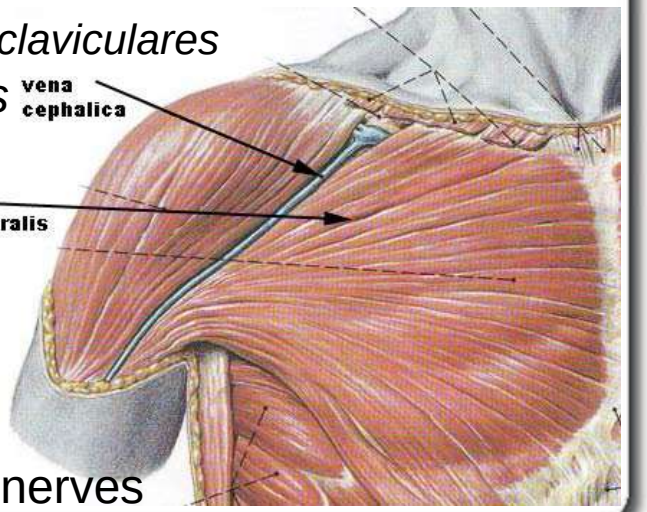
- Boundaries – boundaries of the sternum
- Surface anatomy:
  - ✓ skin – thin, poorly moving and hairy
  - ✓ subcutaneous tissue – loose connective tissue, no fat tissue
    - *rr. cutanei anteriores pectorales I-VII*
    - occasionally – *ossa suprasternalia, m. sternalis*
  - ✓ *sternum*
    - *rr. sternales (a. thoracica interna)*
- Clinically important:
  - ✓ sternal puncture
  - ✓ median sternotomy



Infraclavicular region
Regio infraclavicularis

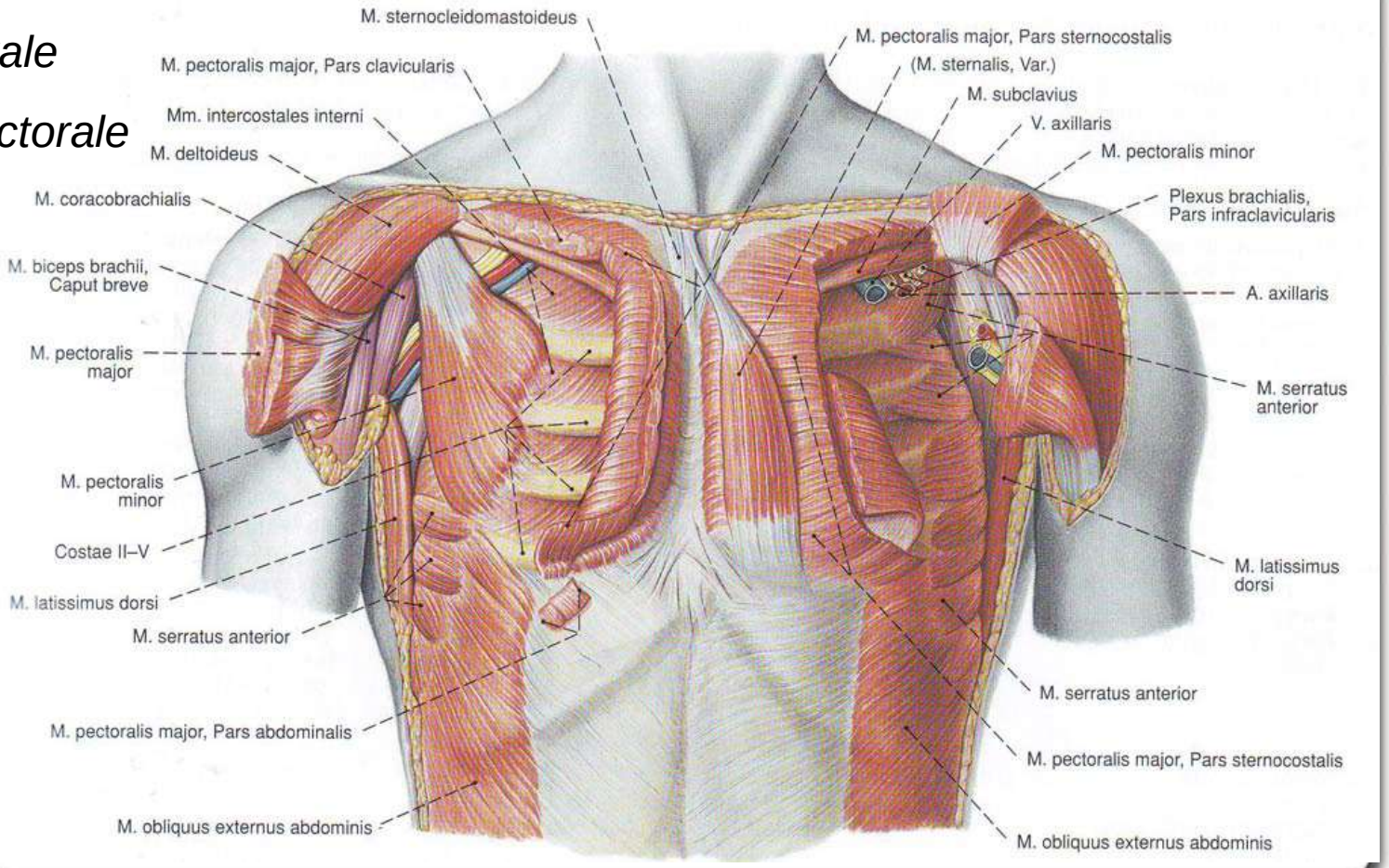
- Boundaries:
  - ✓ superior boundary – clavicle
  - ✓ inferior – horizontal line through:
    - third rib (in men)
    - upper rim of the breast (in women)
  - ✓ medial – the sternum
  - ✓ lateral – *sulcus deltoideopectoralis*
- Surface anatomy:
  - ✓ skin and subcutaneous tissue – poorly developed
    - *nn. cutanei ant. et lat., nn. supraclaviculares*
  - ✓ superficial layer - *fascia pectoralis*
  - ✓ *m. pectoralis major*
    - *sulcus deltoideopectoralis* ⇨ *trigonum deltoideopectorale*
    - *sulcus interpectoralis*
  - ✓ *fascia pectoralis* – deep layer *(fascia clavipectoralis)*
  - ✓ *m. pectoralis minor*, vessels and nerves





Infraclavicular region
Regio infraclavicularis

- *trigonum clavipectorale*
- *trigonum pectorale*
- *trigonum subpectorale*

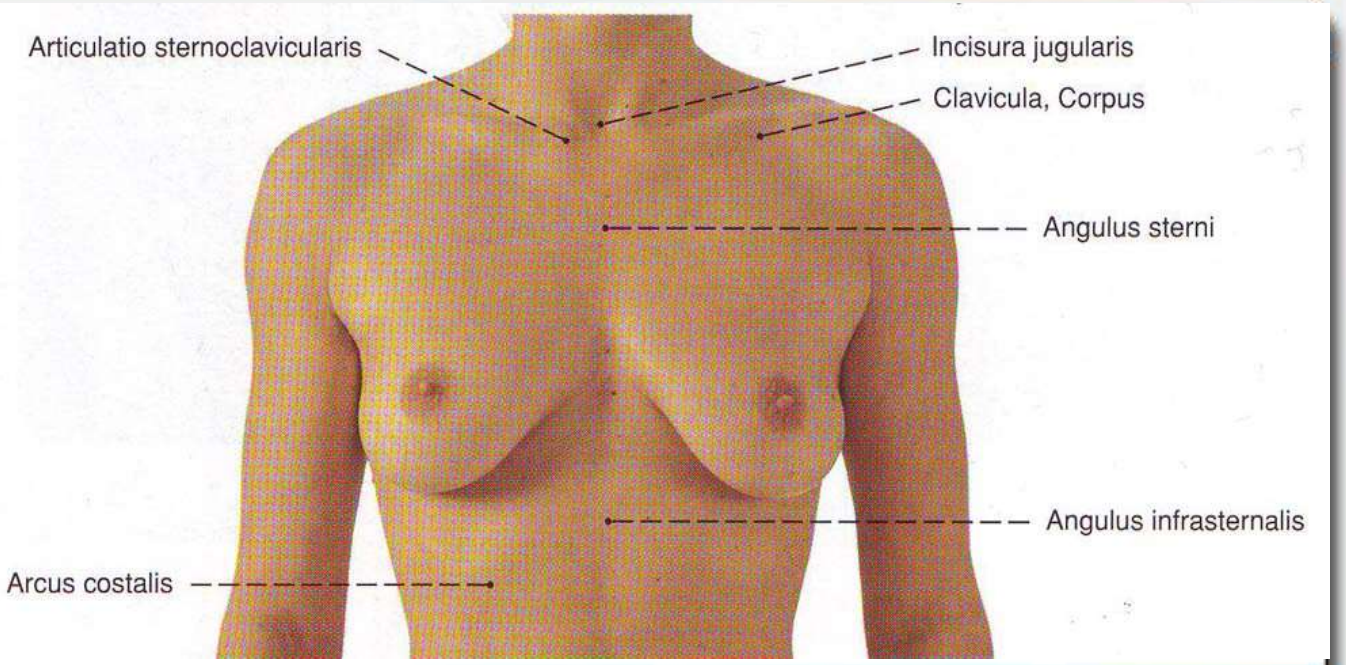


Infraclavicular region
Regio infraclavicularis

infraclavicular block anesthesia

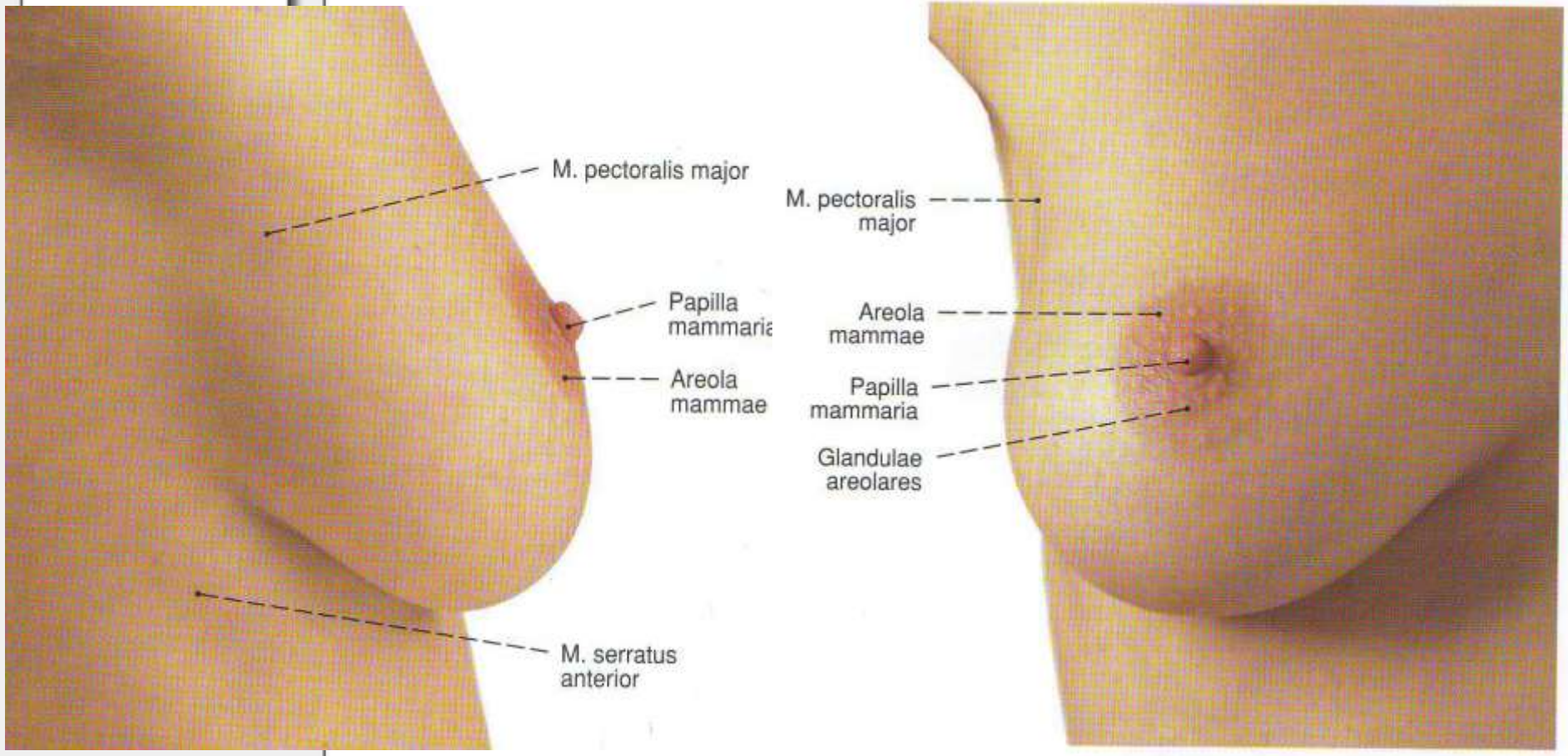
skin turgor test

surgical approach to brachial plexus

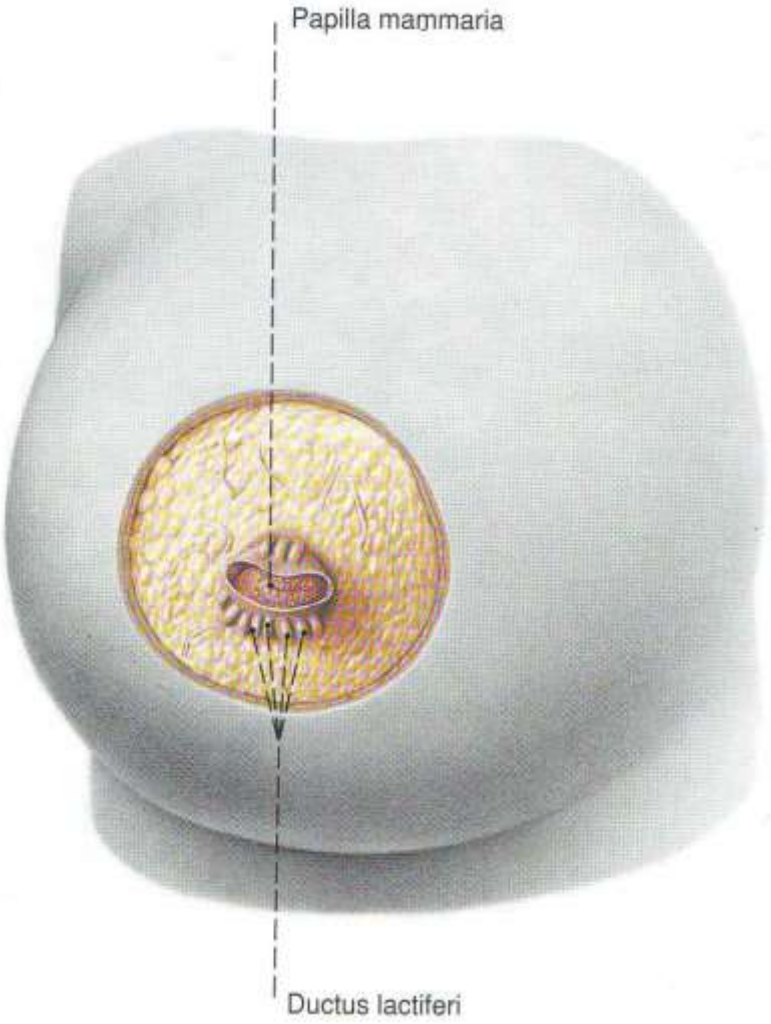


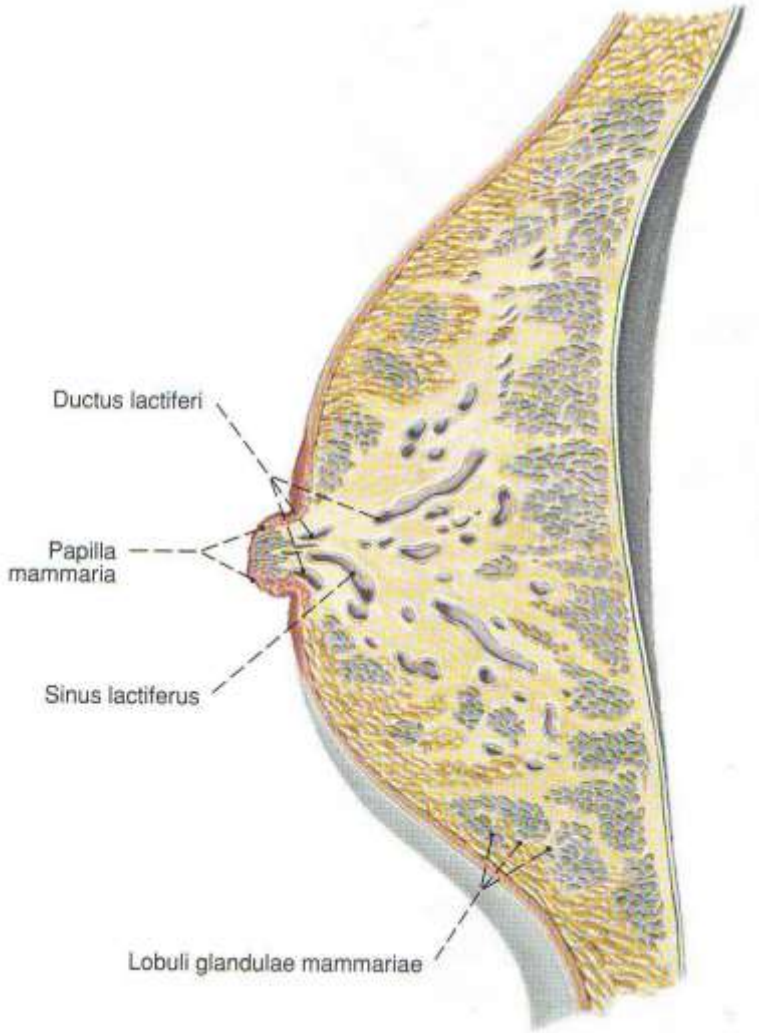
Mammary region, *(Regio mammaria)*

Mammary gland, breast *(mamma)* Topography

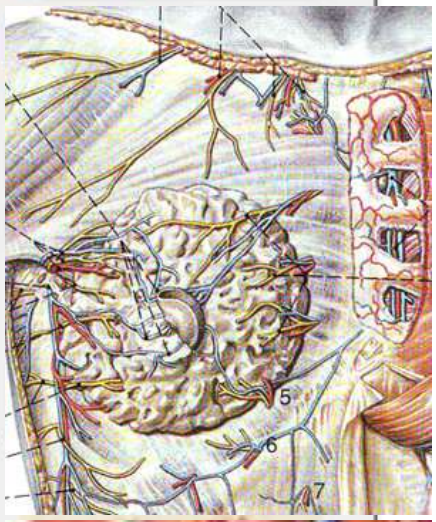


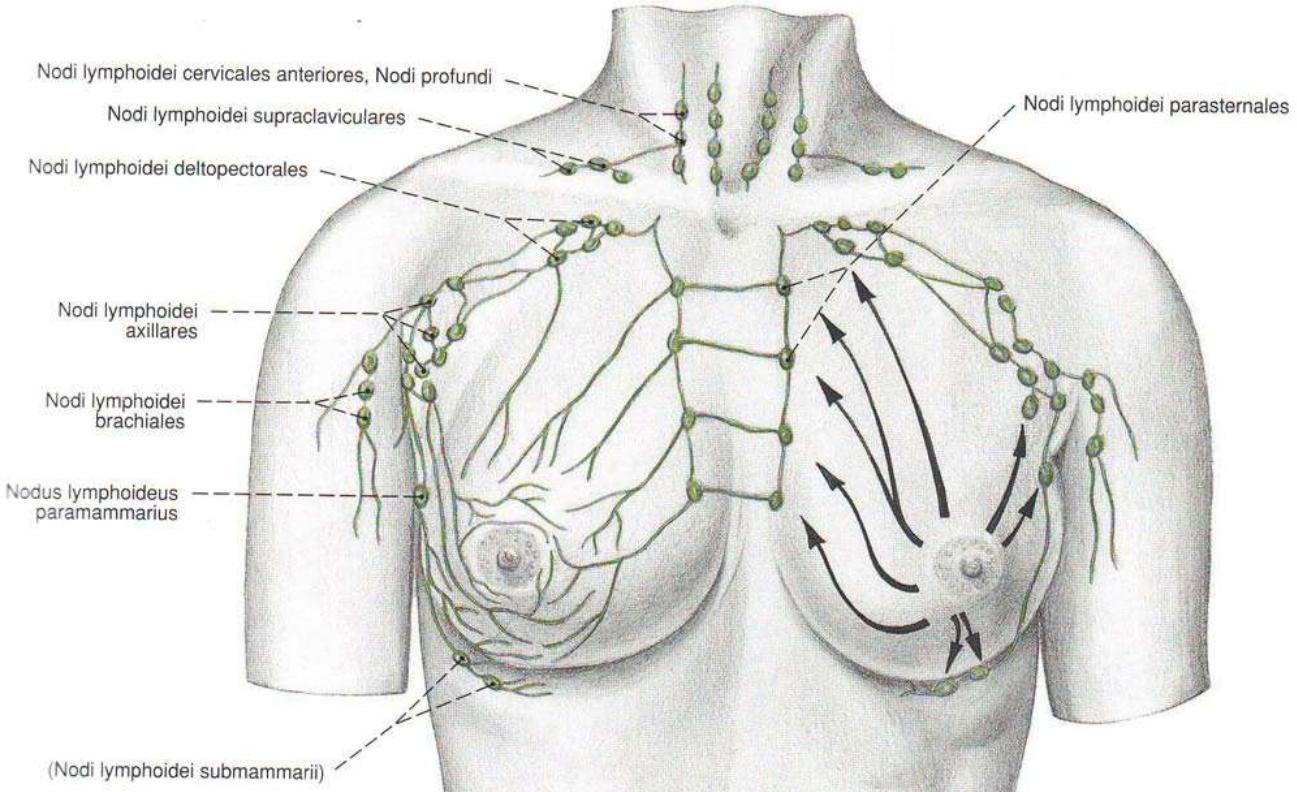
Anatomical structure





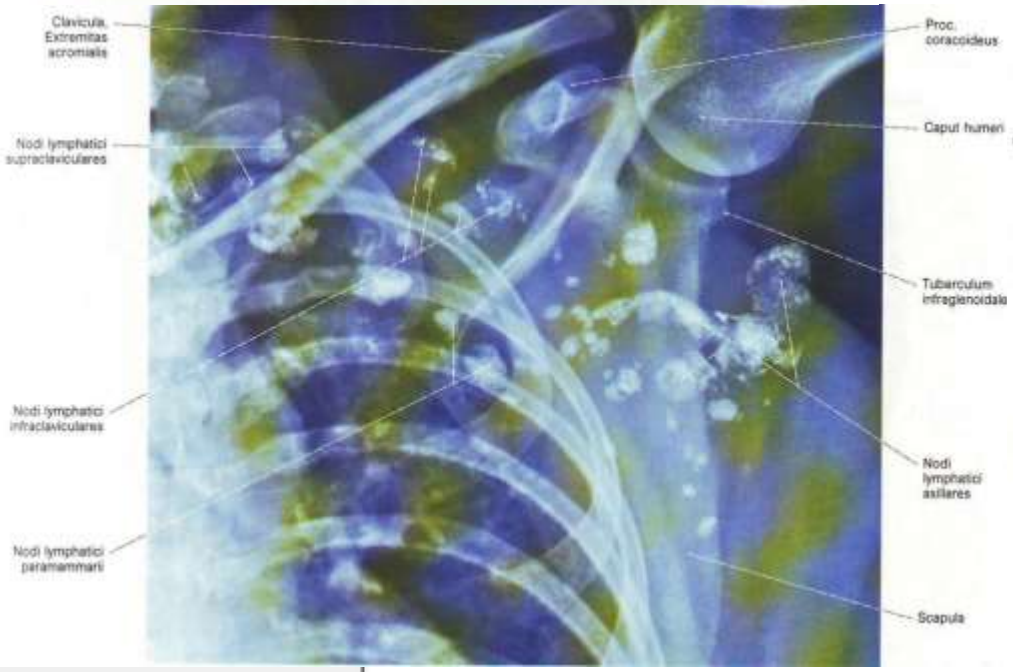
Blood supply, venous and lymphatic drainage

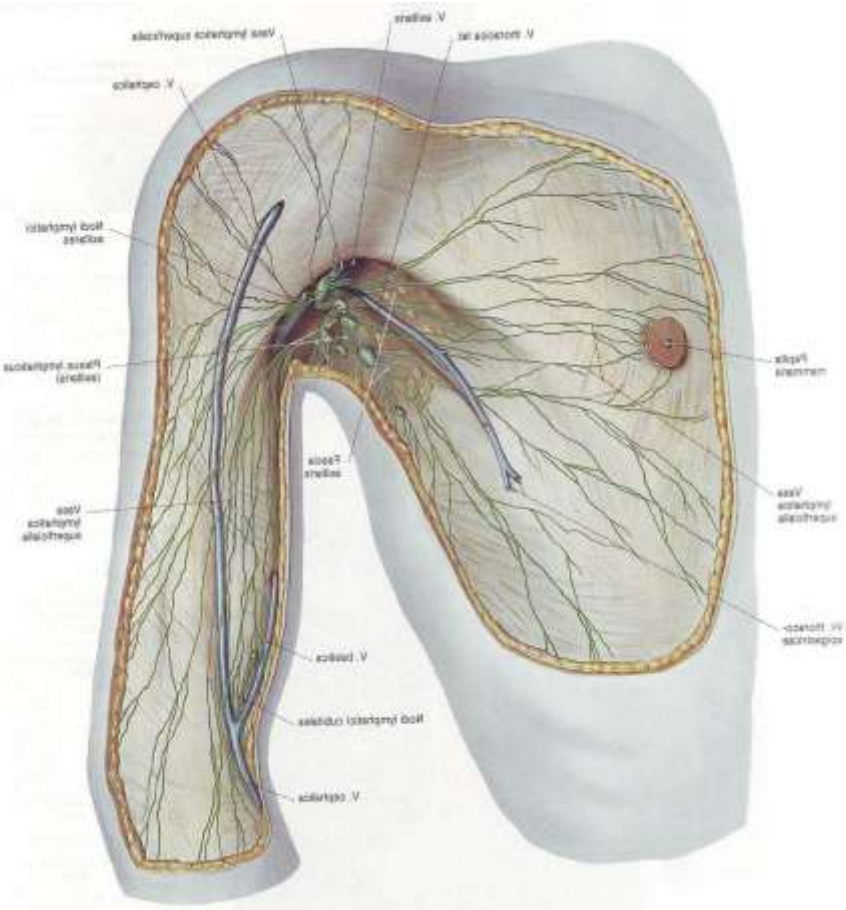




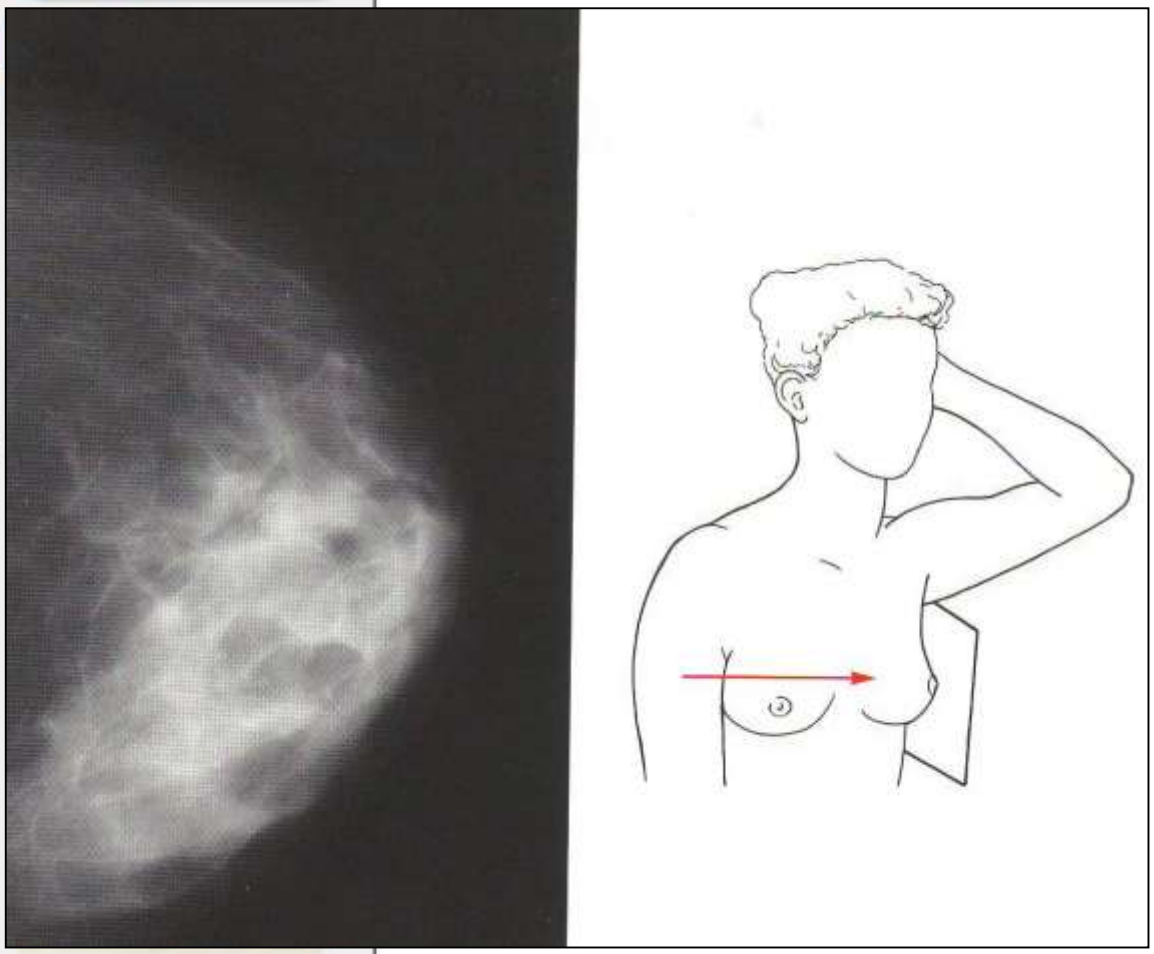
- superficial plexus ⇨ axillary lymph nodes (75% of the lymph)
- deep (fascial) plexus ⇨ mediastinal lymph nodes
  - ✓ lymphatic pathway of *Grossman* ⇨ apical (infraclavicular) lymph nodes
  - ✓ lymphatic pathway of *Gerota* ⇨ subdiaphragmatic inferior lymph nodes

Lymphatic drainage





Clinical significance



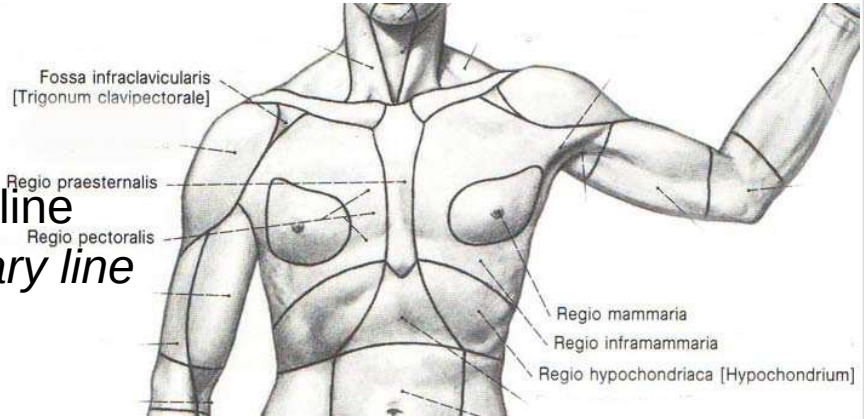
Mammography

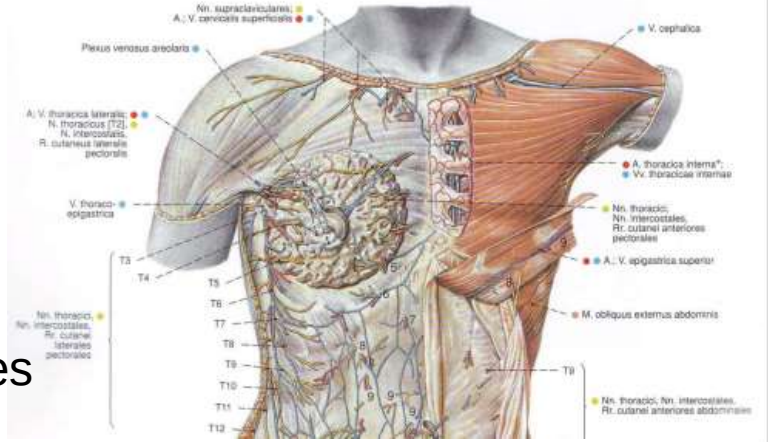
Gynecomastia
Gr. *γυνή gyne,* "woman" and *μαστός mastos,* "breast"

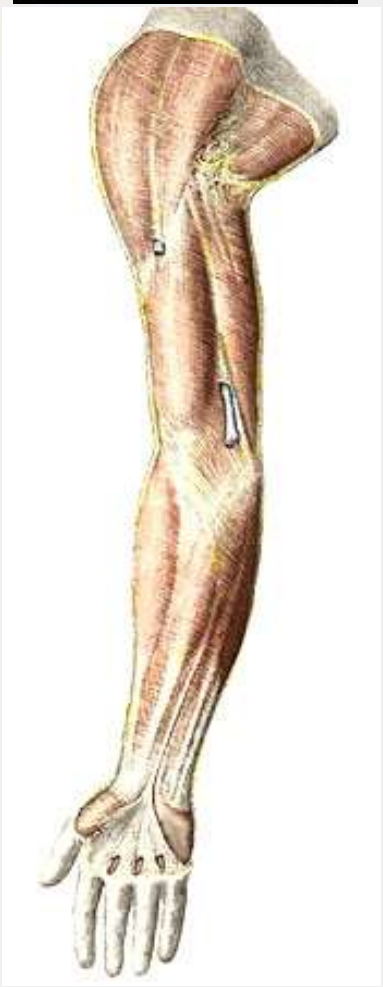
Breast cancer
Paget's disease *(morbus Paget)*

Inframammary region
Regio inframammaria

- Boundaries:
  - ✓ upper – 6th rib
  - ✓ lower – costal arch
  - ✓ medial – (mid)sternal line
  - ✓ lateral – *anterior axillary line*
- Surface anatomy:
  - ✓ skin – relatively thin
  - ✓ subcutaneous tissue – poorly developed
    - *rr. cutanei anteriores et laterales pectorales*
    - venous blood vessels
  - ✓ *fascia thoracica*
  - ✓ muscle layer
    - *m. serratus anterior*
    - upper portion of external oblique muscle
  - ✓ ribs and intercostal muscles

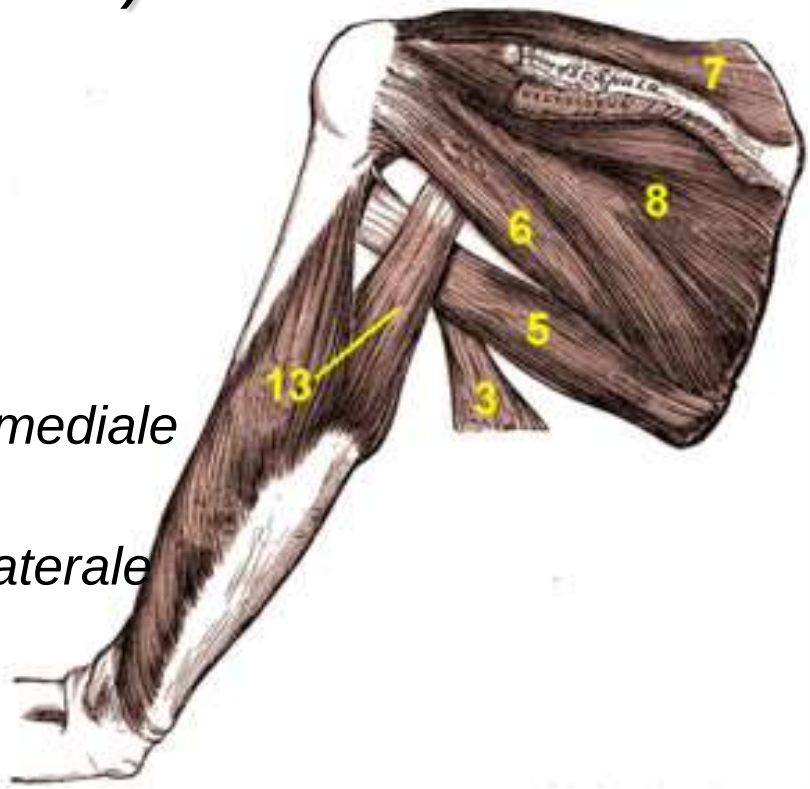






Axillary region
Regio axillaris

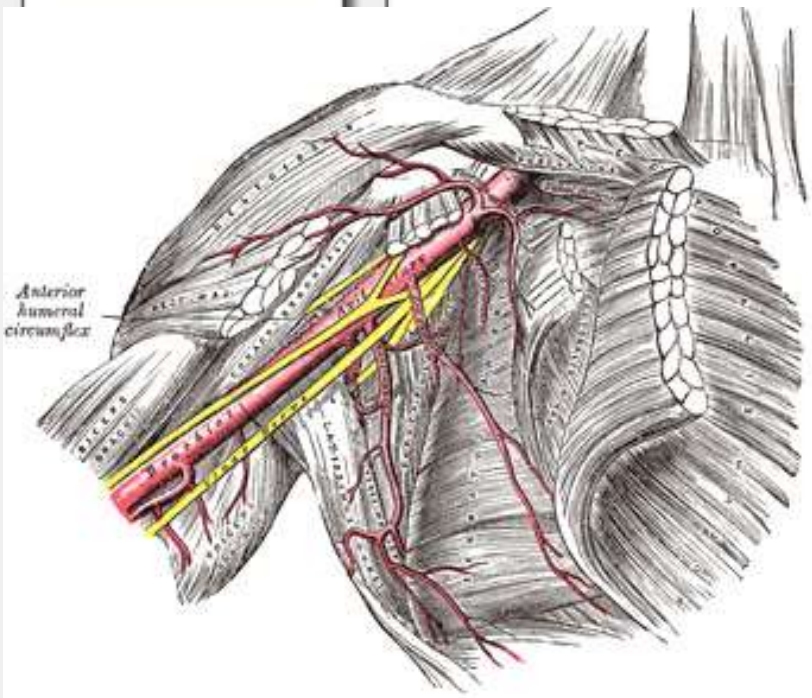
- *Fossa axillaris* (axilla) – four walls:
  - ✓ anterior wall
  - ✓ medial
  - ✓ lateral
  - ✓ posterior wall:
    - *foramen axillare mediale (trilaterum)*
    - *foramen axillare laterale (quadrilaterum)*

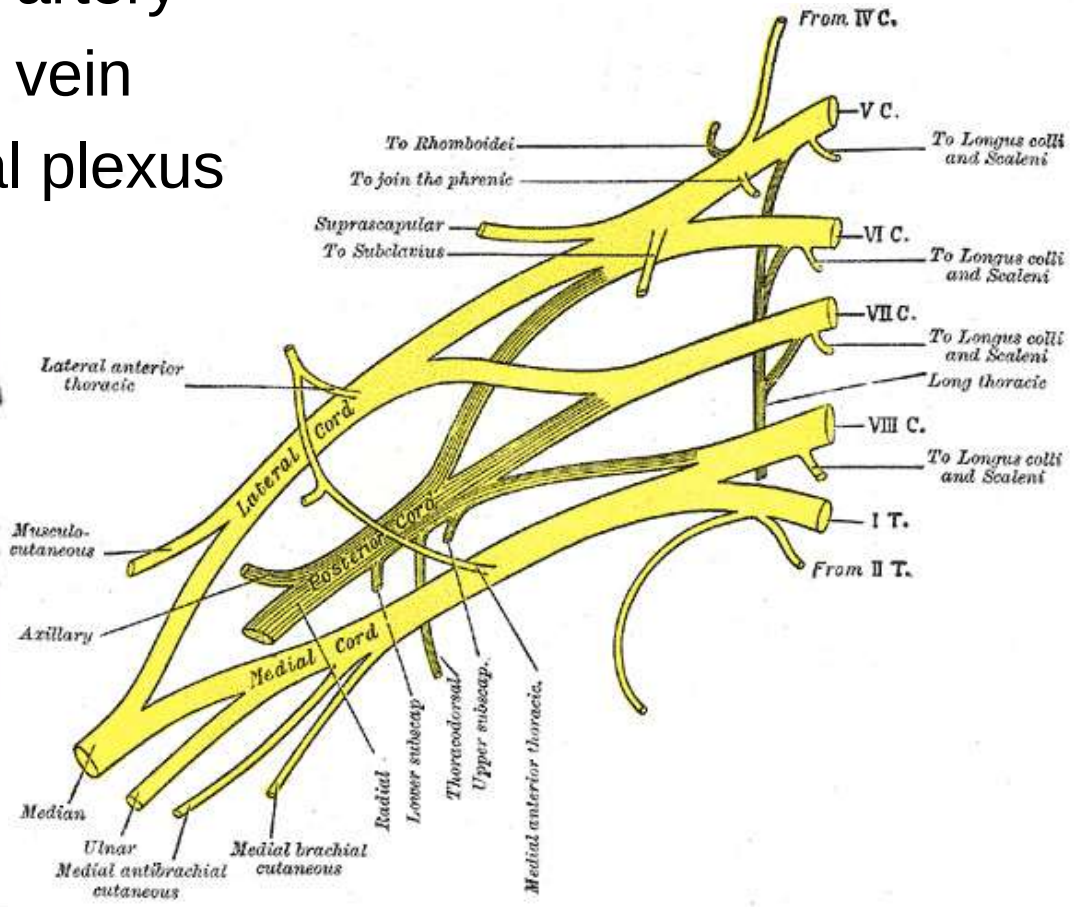


- Skin:
  - ✓ rich sebaceous glands: armpit boils (furuncles)
  - ✓ apocrine sweat glands: *hidradenitis suppurativa*

Contents of axilla

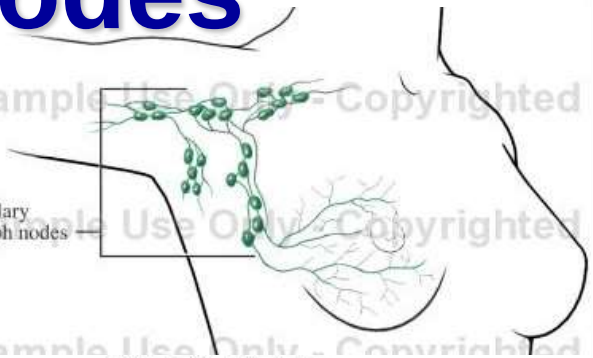
- Axillary neurovascular bundle:
  - ✓ axillary artery
  - ✓ axillary vein
  - ✓ brachial plexus

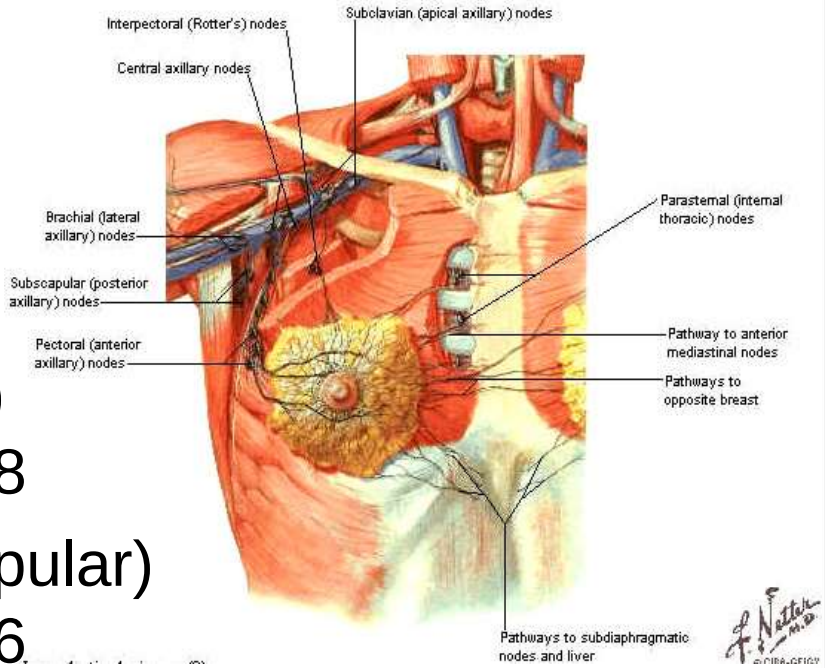




Axillary lymph nodes

- 5 groups (20-40 nodes):
  - ✓ apical (infraclavicular) lymph nodes – 6-10
  - ✓ central lymph nodes – 4-6
  - ✓ lateral (humeral) lymph nodes – 3-8
  - ✓ anterior (pectoral) lymph nodes – 3-8
  - ✓ posterior (subscapular) lymph nodes – 3-6

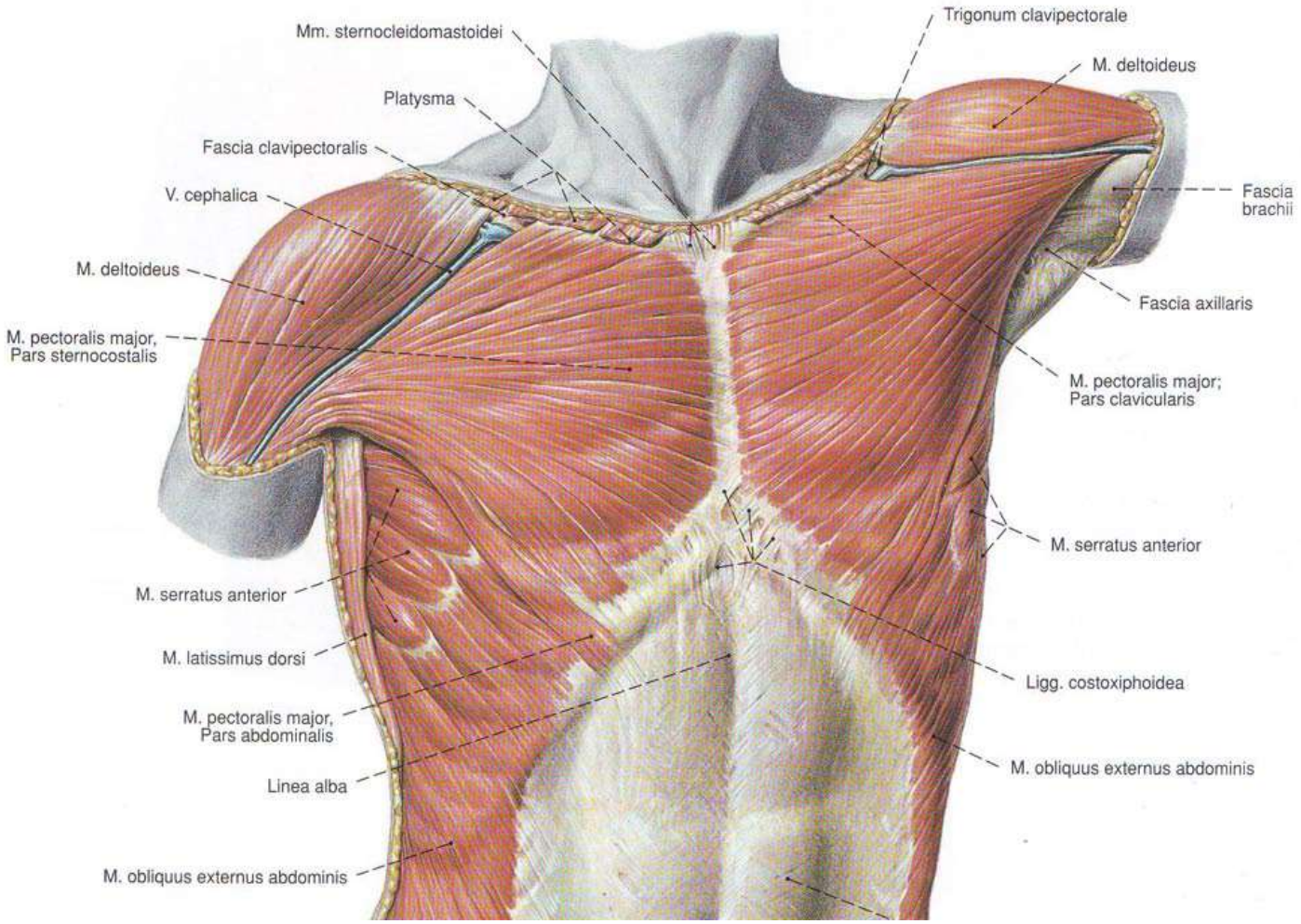




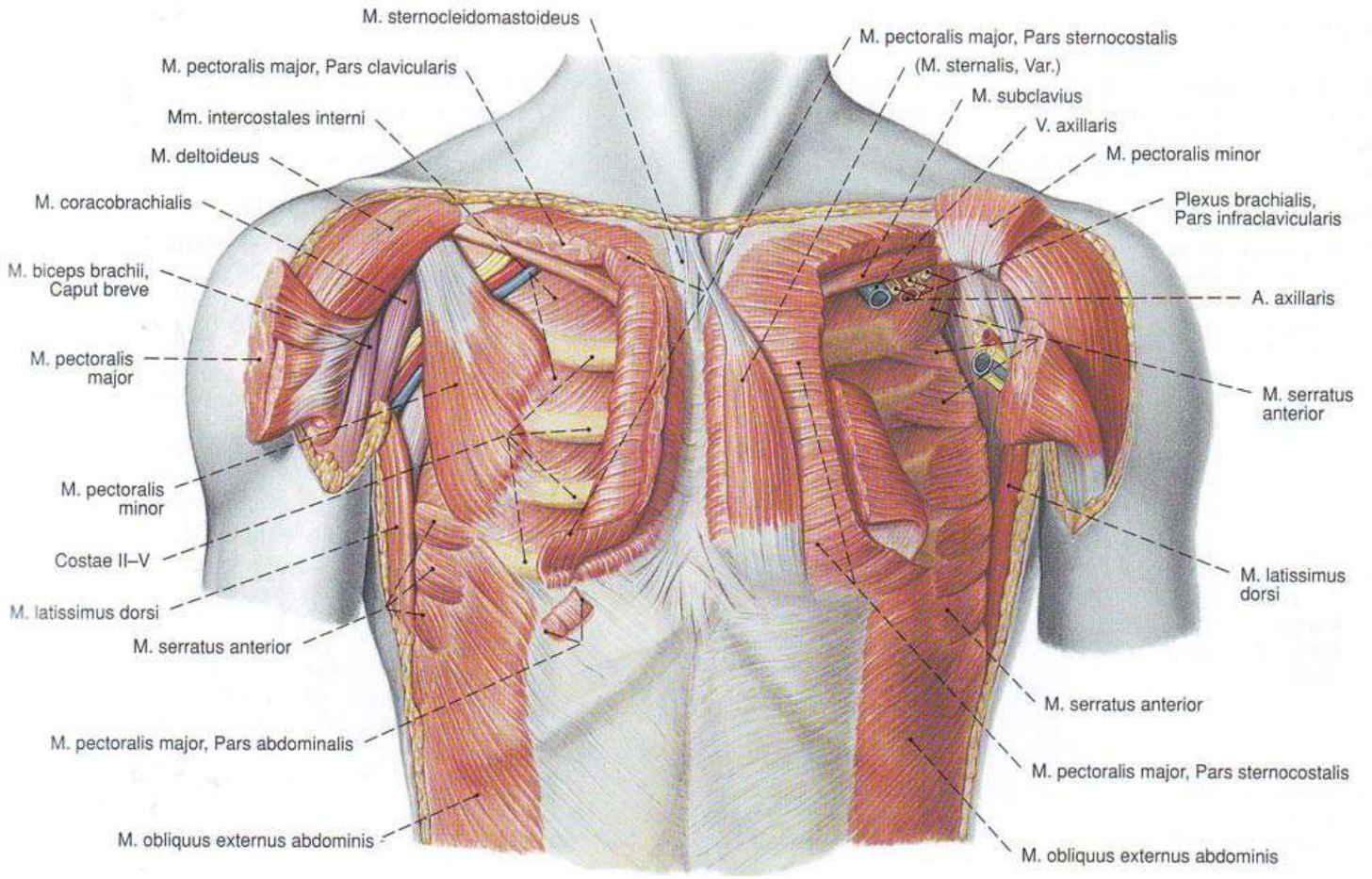
Thoracic wall

- skin
  - ✓ anterolateral – thin (excl. sternum) and hairy
  - ✓ abundance of sebaceous and sweat glands
- subcutaneous tissue – variable thickness
  - ✓ anterior and lateral branches of intercostal nerves
  - ✓ arterial and venous networks – *v. thoracoepigastrica*
- superficial and deep fascia
- intercostal spaces – ribs and intercostal muscles
- *fascia endothoracica s. fascia parietalis thoracis*
- parietal pleura

Muscles of the thoracic wall

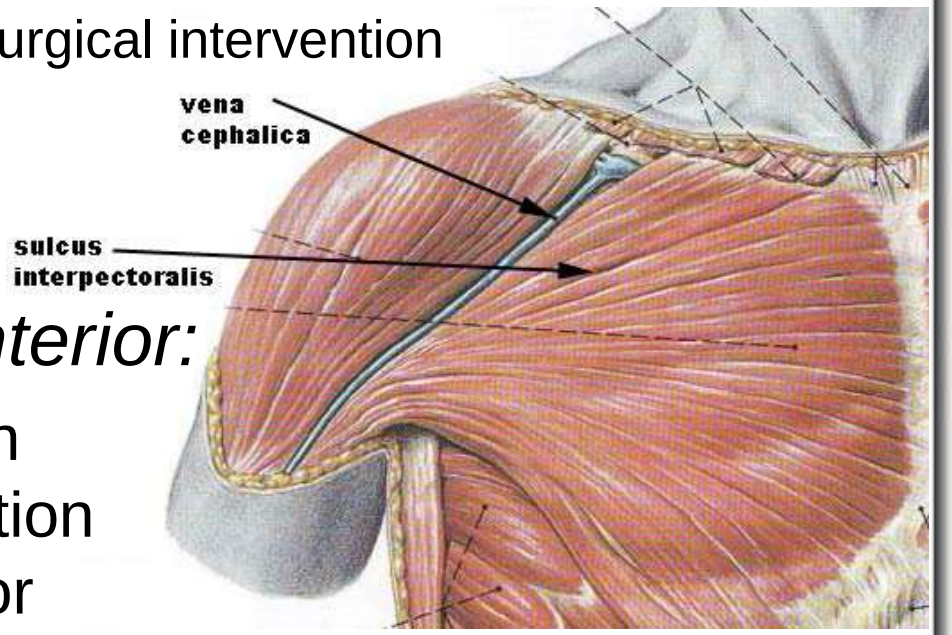


Muscles of the thoracic wall



Clinical significance

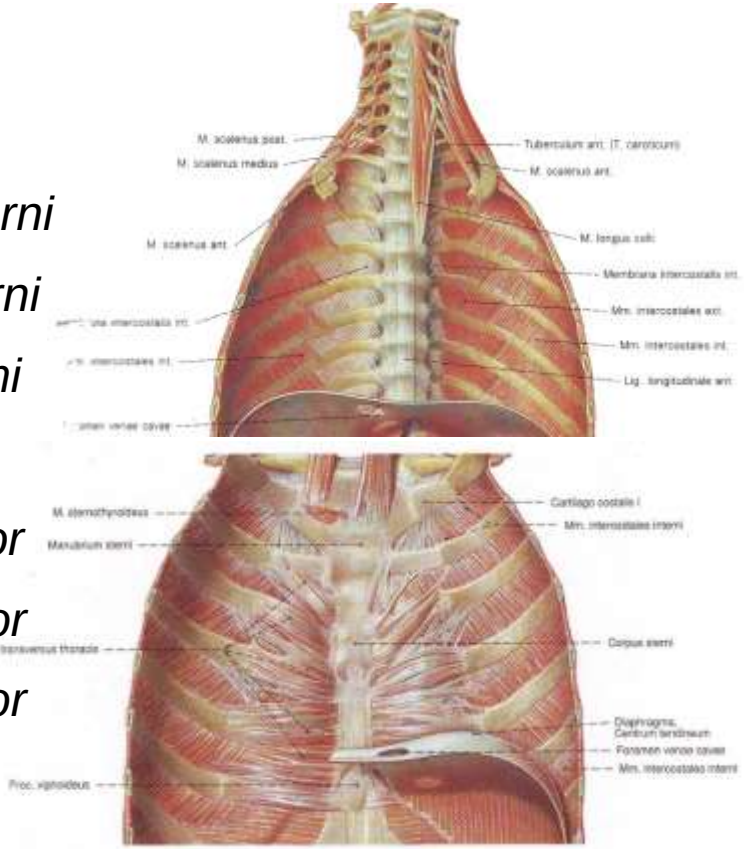
- *m. pectoralis major*:
  - ✓ *sulcus deltoideopectoralis – vena cephalica*
  - ✓ *sulcus interpectoralis* – a benchmark for surgical intervention on the breast



- *m. serratus anterior:*
  - ✓ deformation in scapular location after trauma or surgical intervention

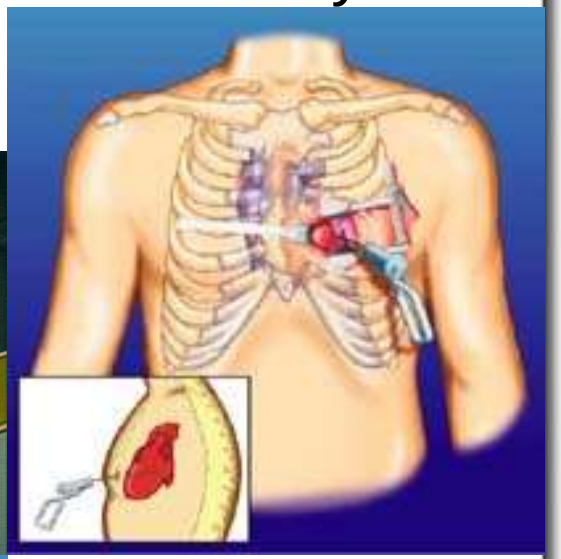
Intercostal spaces, *spatia intercostalia*

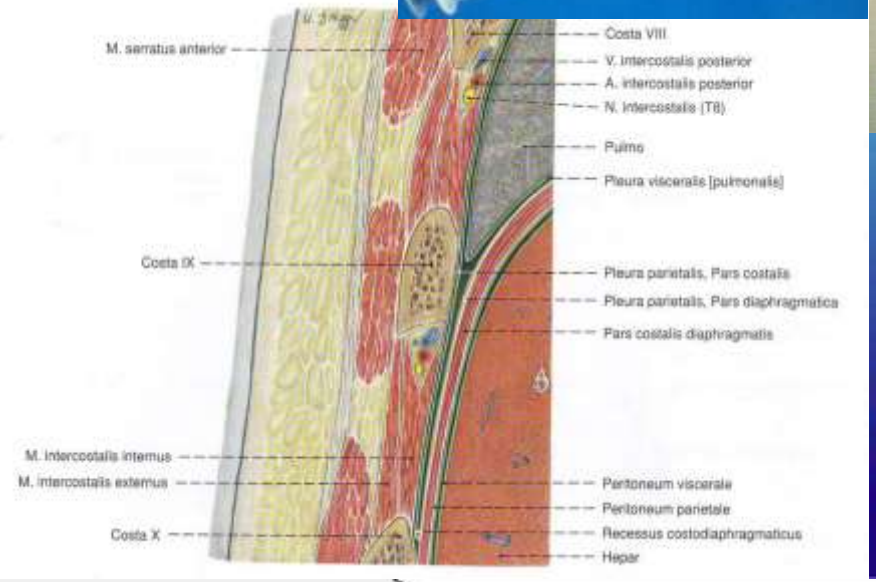
- number – 11
- structure:
  - ✓ intercostal muscles
    - *mm. intercostales externi*
    - *mm. intercostales interni*
    - *mm. intercostales intimi*
  - ✓ neurovascular bundle:
    - *v. intercostalis posterior*
    - *a. intercostalis posterior*
    - *n. intercostalis posterior*

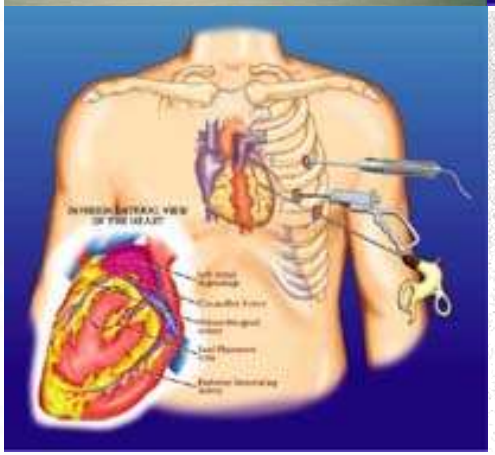


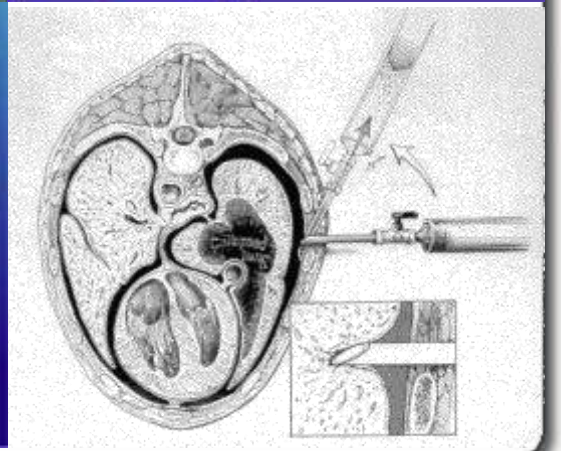
Pleural puncture: thoracocentesis

- approach to thoracoscopy and thoracotomy:
  - ✓ 5th, 6th, 7th intercostal space



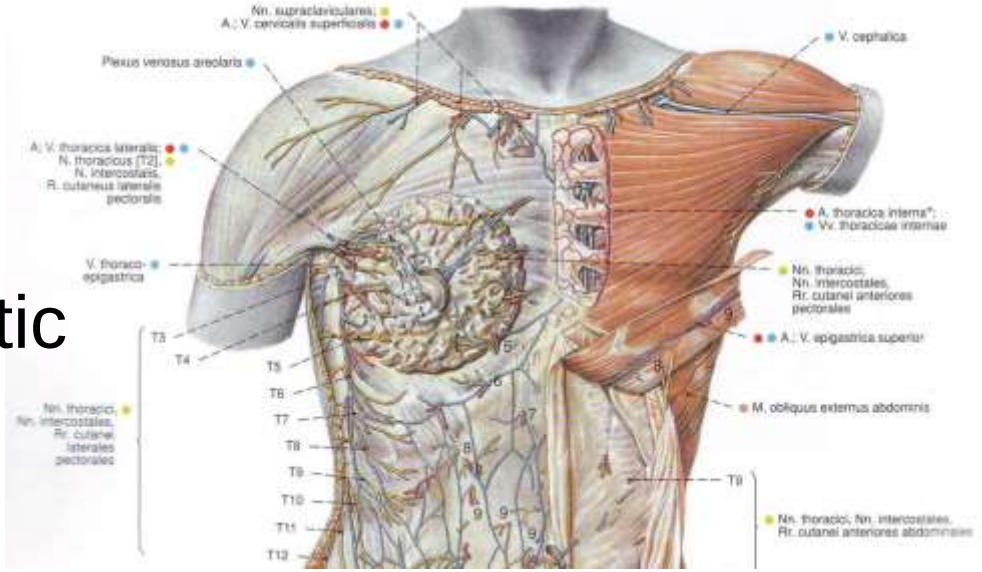






Lymphatic vessels and lymph nodes

- ✓ intercostal
- ✓ parasternal
- ✓ diaphragmatic



Clinical significance

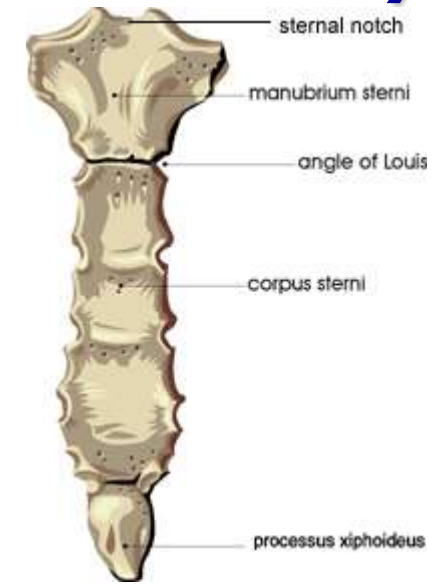
- ✓ possible metastatic involvement of the parasternal group in breast cancer

Wilhelm Frederick von Ludwig
1790-1865

Antoine Louis
1723 – 1792

Sternal angle (angle of Louis)

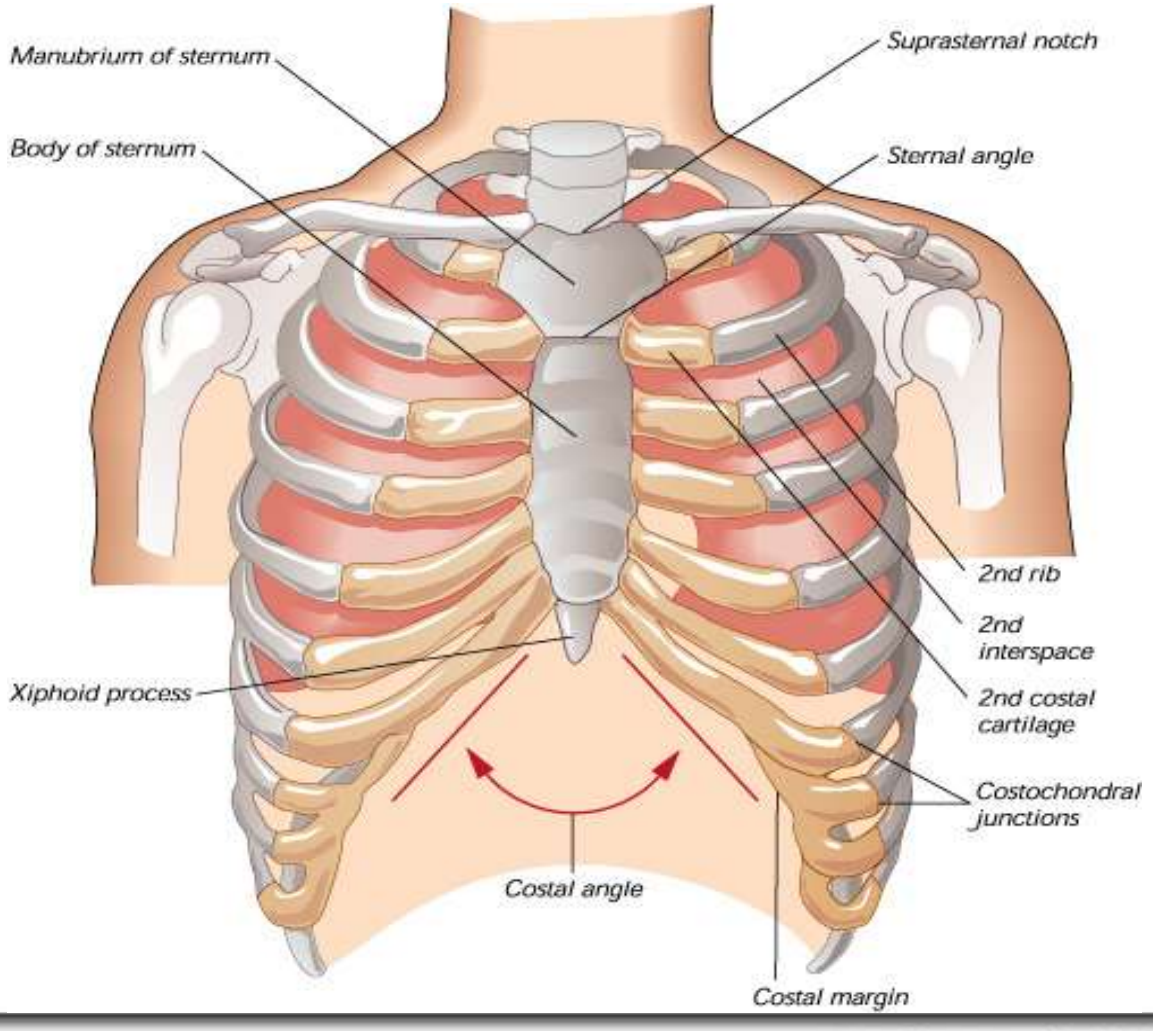
- palpable junction between manubrium and sternal body - corresponds to Th4 and 2nd rib
- a palpable clinical landmark in surface anatomy:
  - ✓ useful place to start counting ribs – it is continuous with rib 2
  - ✓ tracheal bifurcation
  - ✓ the transition from aortic arch to descending aorta
  - ✓ the azygos vein drains into the superior cava



Angle of Louis

Thoracic cage *(Thorax)*

- a truncated cone flared in the anterior-posterior direction

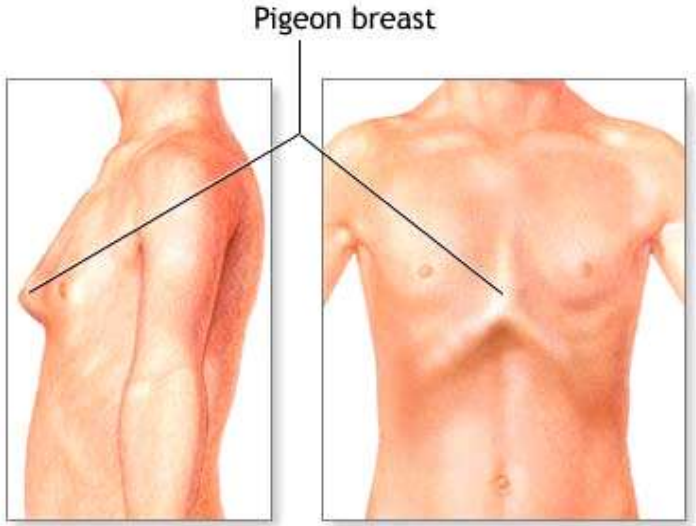


Clinical significance

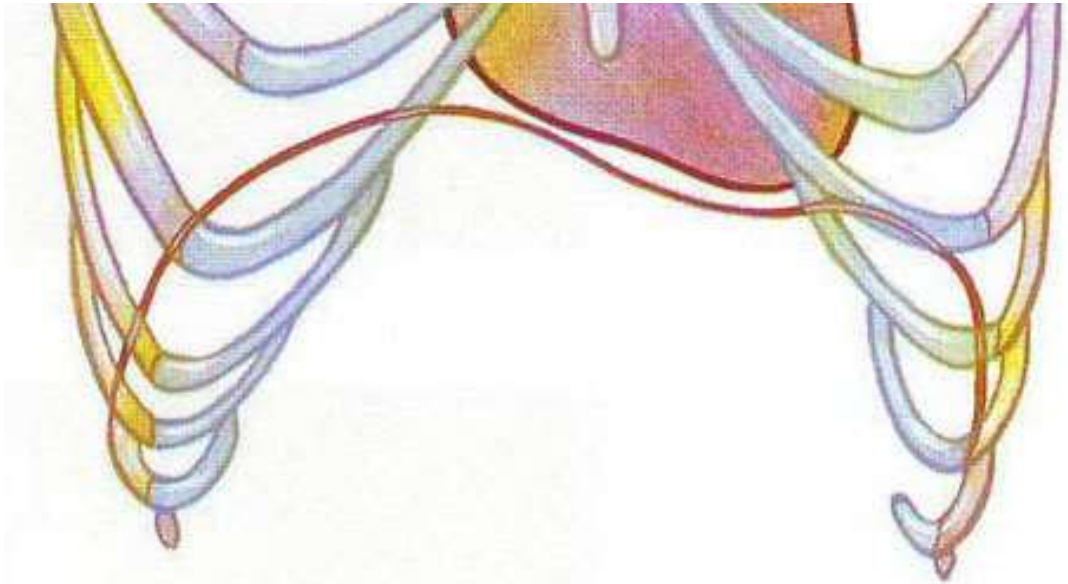
- Variations in the size and shape of the chest

- **Barrel chest:** an increase in the anterior-posterior diameter of the chest wall

Pectus excavatum
(sunken or funnel chest):
a deformity in which the breastbone is sunken into the chest

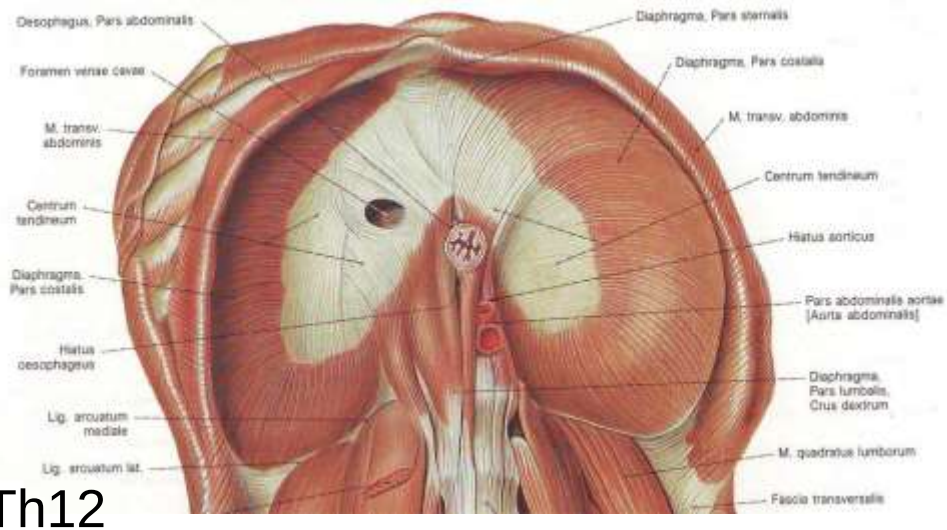


- *Pectus carinatum*
(pigeon chest):
a malformation of the chest characterized by a protrusion of the sternum and ribs



Diaphragm
(diaphragma)

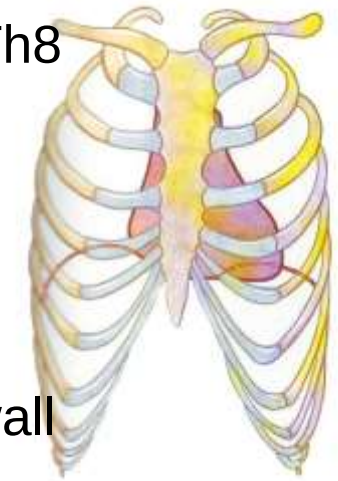
Structure and topography



A shared wall:

- lumbar part
- costal part
- sternal part
- central tendon:
  - aortic hiatus – Th12
  - esophageal hiatus – Th10
  - caval opening (foramen venae cavae) – Th8

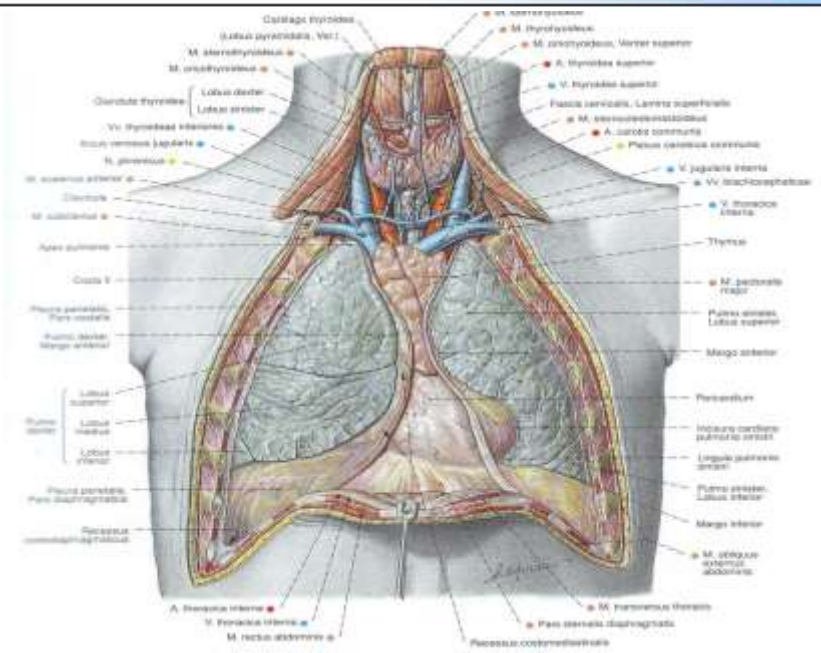
- The level of the domes varies:
  - ✓ age-dependant
  - ✓ elastic force of the lung tissue
  - ✓ pressure of the abdominal viscera
  - ✓ contractions of the anterior abdominal wall muscles

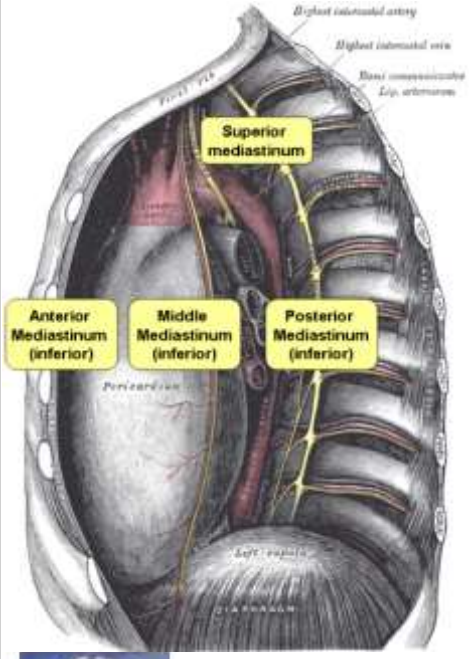


Clinical significance

- Abnormality of structures (birth defects, traumas):
  - ✓ diaphragmatic hernia
- ability to drain the liver above the diaphragm level without opening the pleural cavity
- reflective pain in the right shoulder in processes in organs coming into contact with the diaphragm

- **right** - displacement of the mediastinum
- **left** – intestinal loops in the chest

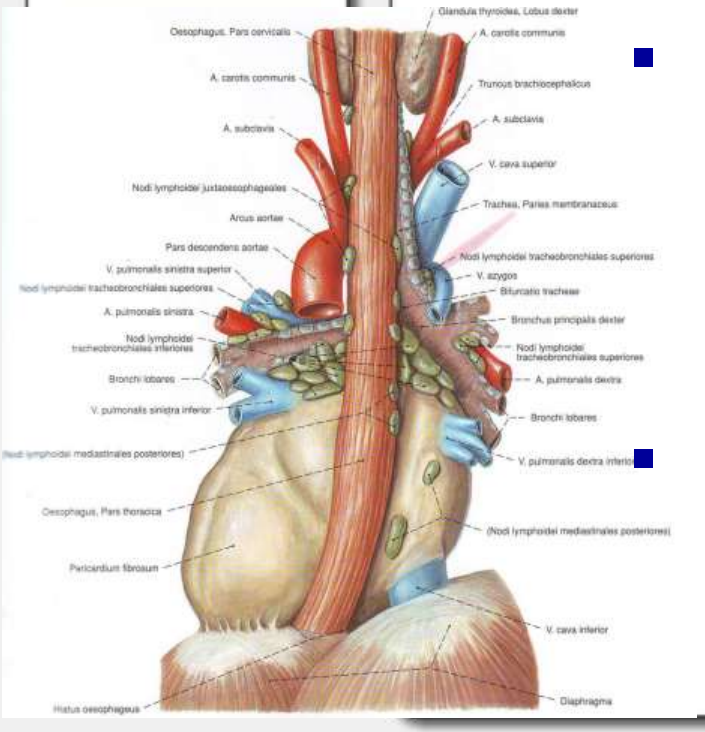




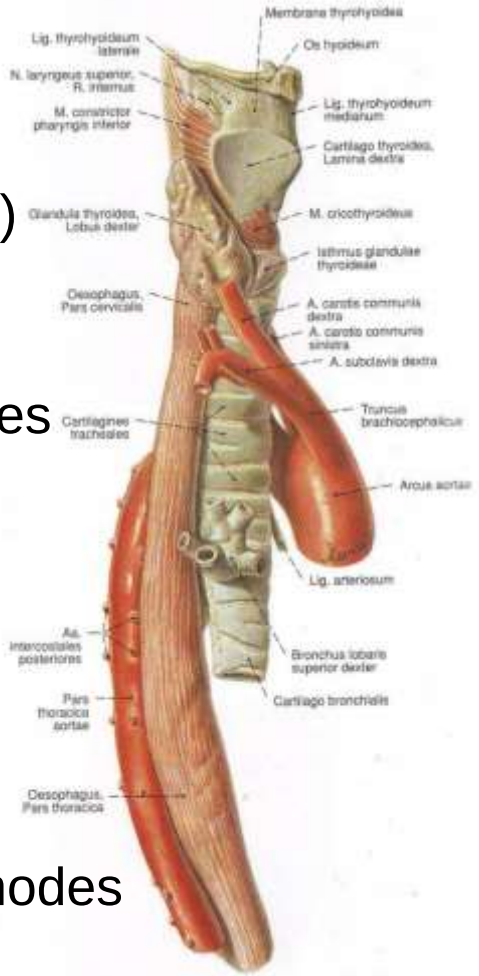
Mediastinum (*mediastinum*)

Superior mediastinum

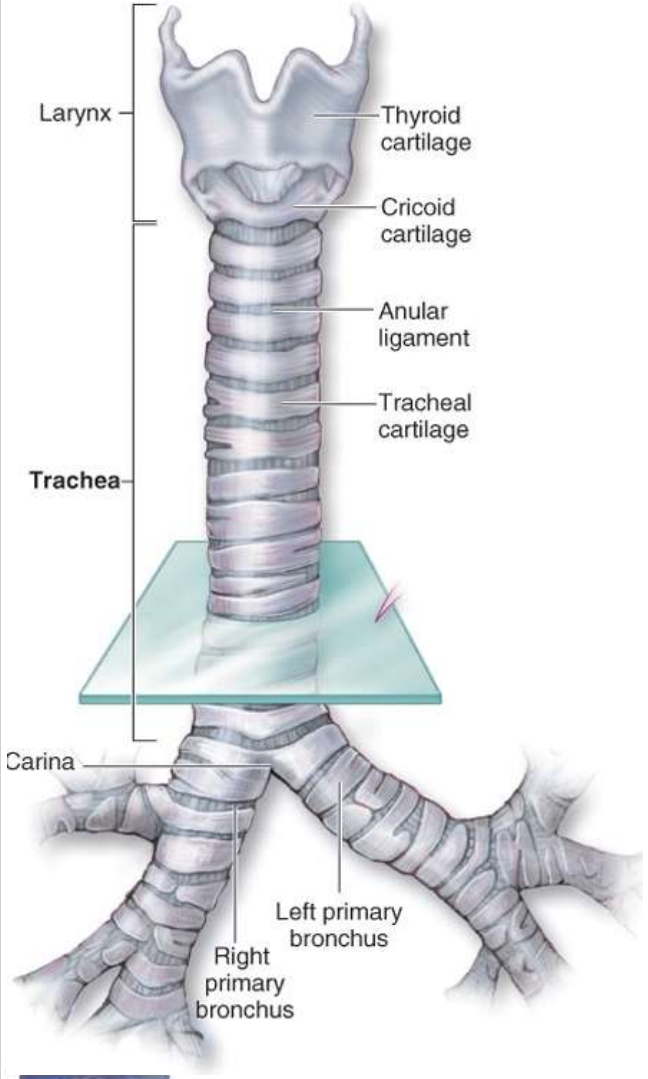
- retrosternal structures:
  - ✓ thymus ⇨ *trigonum thymicum*
  - ✓ great vessels, with the veins (brachiocephalic veins and SVC)

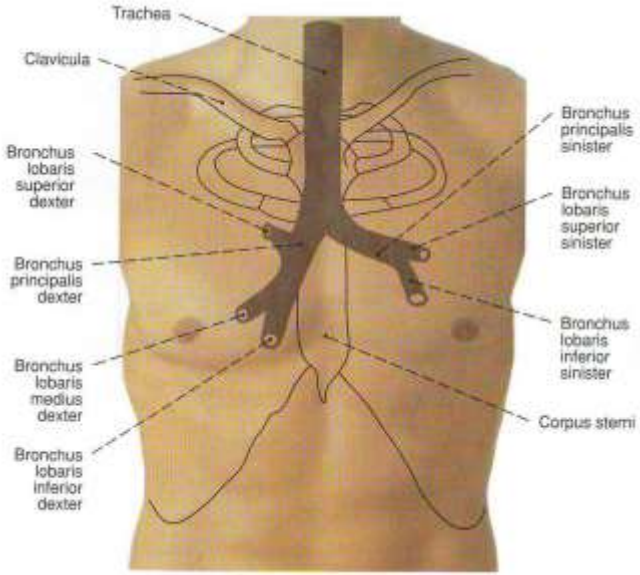


- intermediate structures:
  - ✓ aortic arch and its branches
  - ✓ *cardiac plexus*
  - ✓ *n. vagus*
  - ✓ *phrenic nerve*



- prevertebral structures:
  - ✓ trachea and main bronchi
  - ✓ tracheobronchial lymph nodes
  - ✓ esophagus

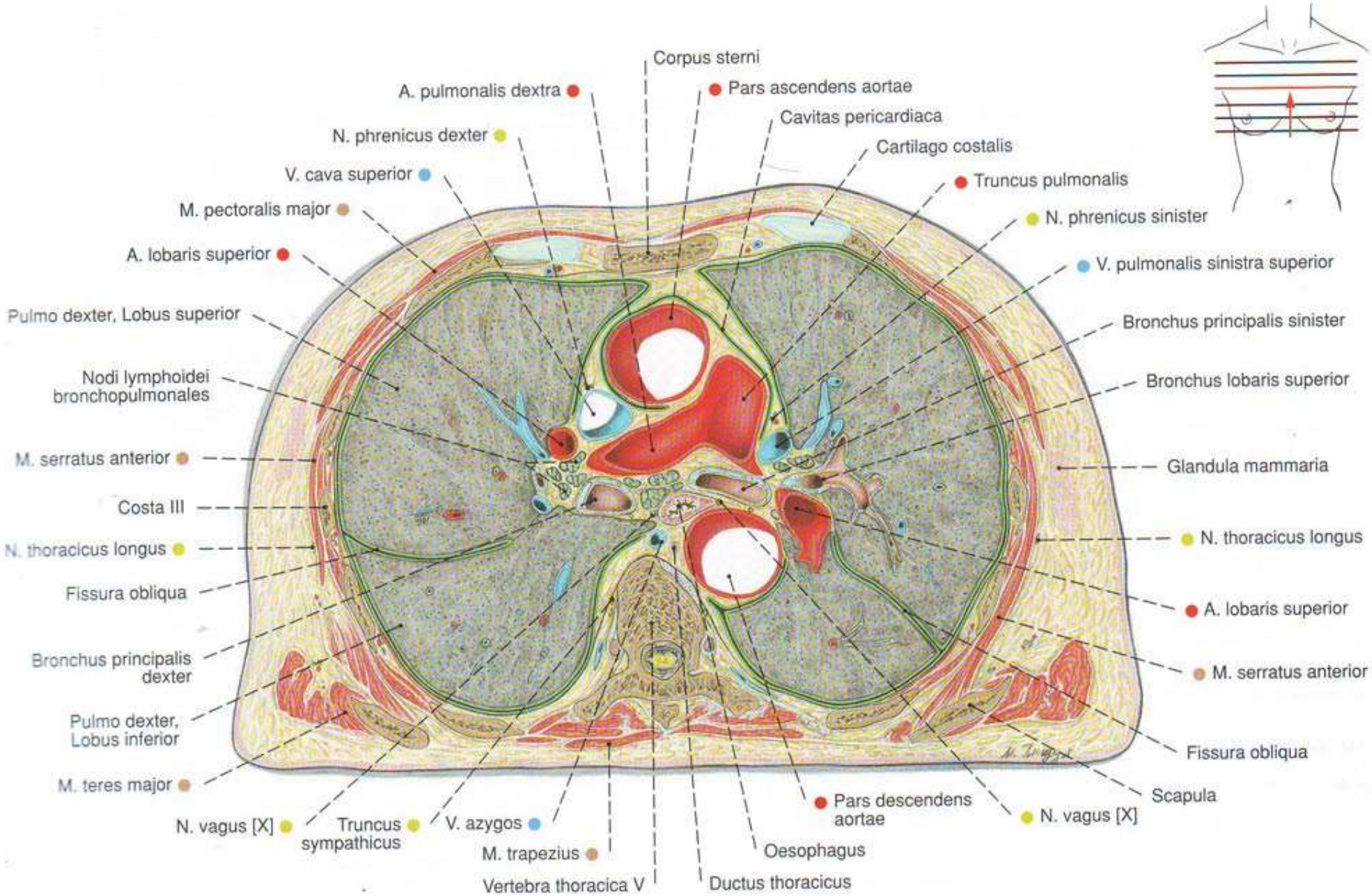




Trachea

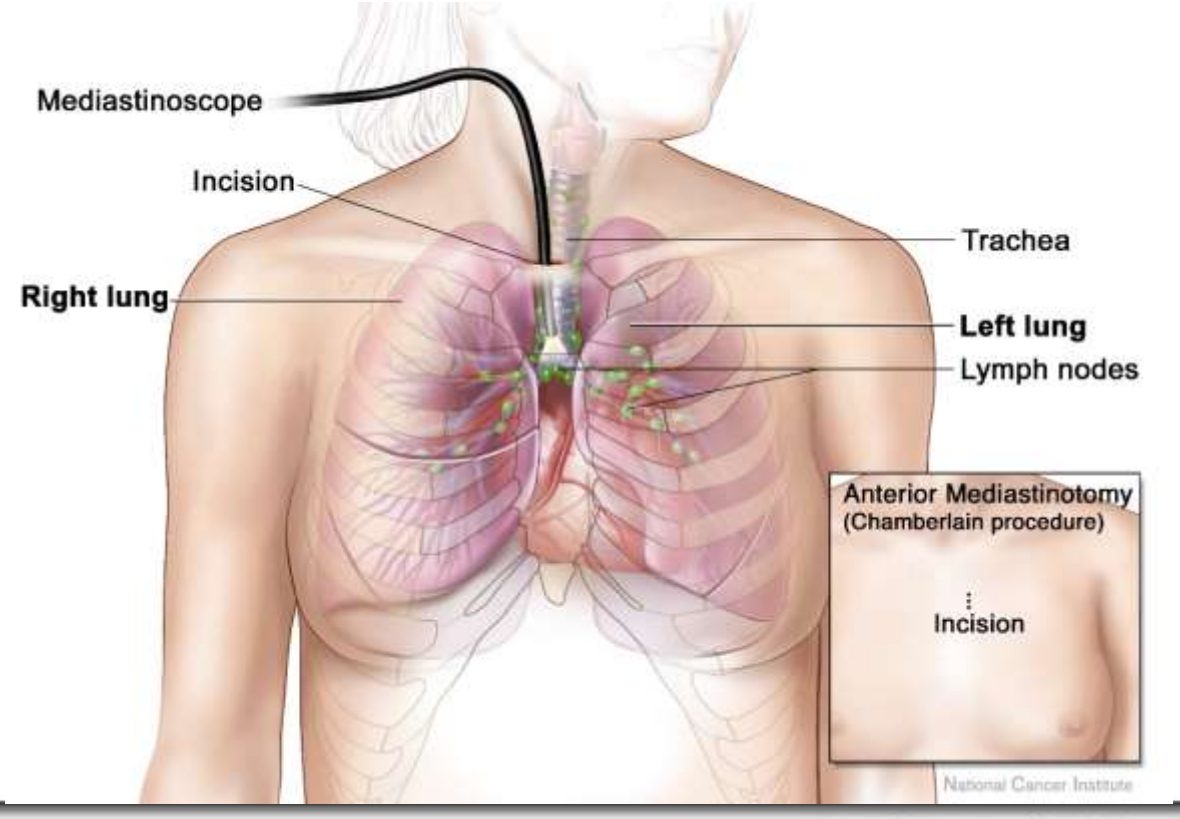
Main (primary) bronchi

Skeletopy and syntopy


Corpus sterni
A. pulmonalis dextra
Pars ascendens aortae
Cavitas pericardiaca
N. phrenicus dexter
Cartilago costalis
V. cava superior
Truncus pulmonalis
M. pectoralis major
N. phrenicus sinister
A. lobaris superior
V. pulmonalis sinistra superior
Pulmo dexter, Lobus superior
Bronchus principalis sinister
Nodi lymphoidei bronchopulmonales
Bronchus lobaris superior
M. serratus anterior
Glandula mammaria
Costa III
N. thoracicus longus
N. thoracicus longus
Fissura obliqua
A. lobaris superior
Bronchus principalis dexter
M. serratus anterior
Pulmo dexter, Lobus inferior
Fissura obliqua
M. teres major
Scapula
Pars descendens aortae
N. vagus [X]
N. vagus [X]
Truncus sympathicus
V. azygos
M. trapezius
Oesophagus
Vertebra thoracica V
Ductus thoracicus

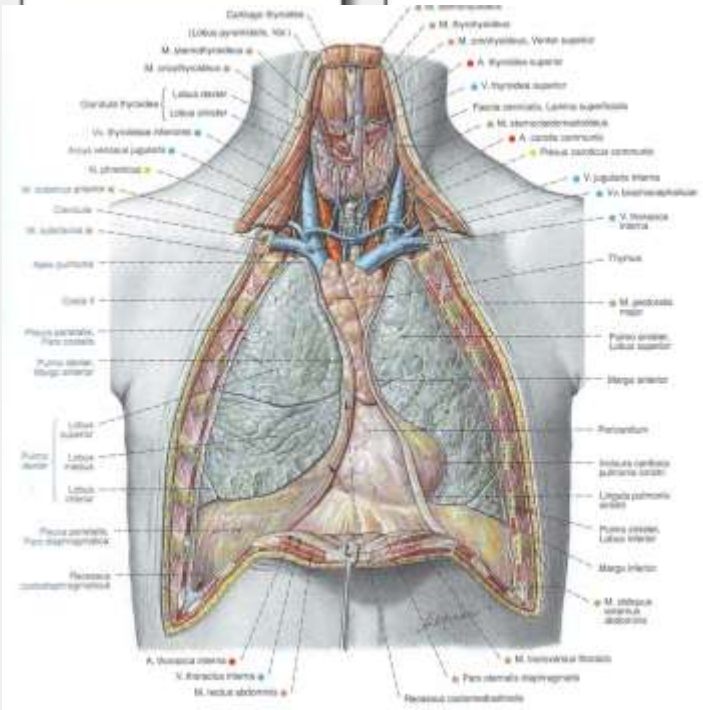
Clinical significance

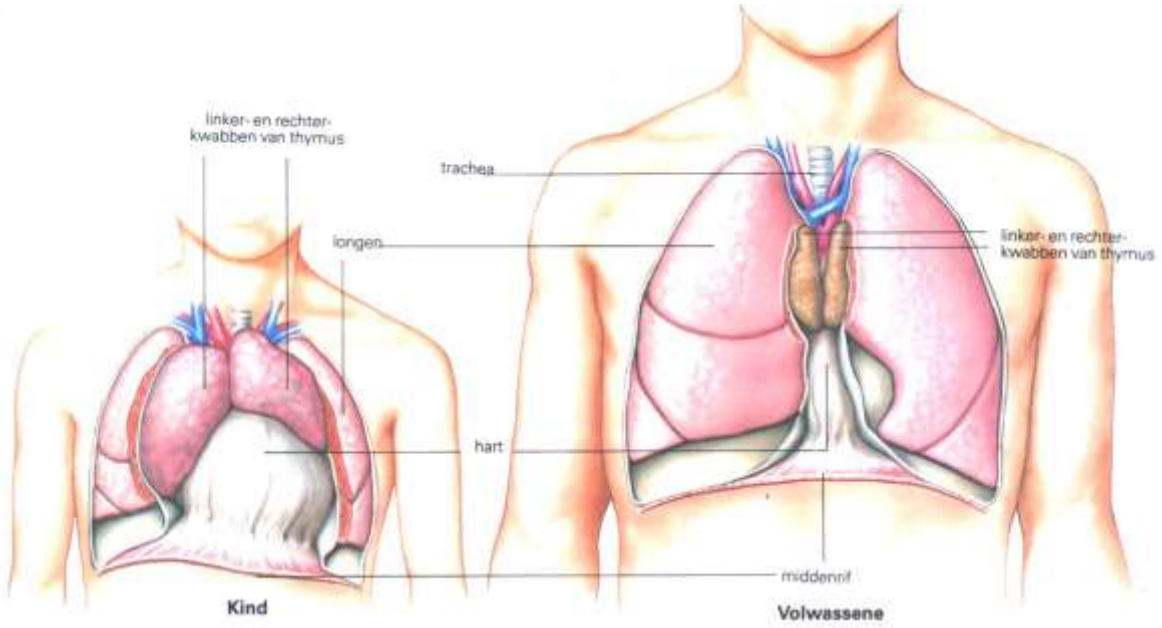
- Mediastinoscopy:
  - ✓ direct inspection of the anterior surface of the trachea to its bifurcation



Anterior mediastinum

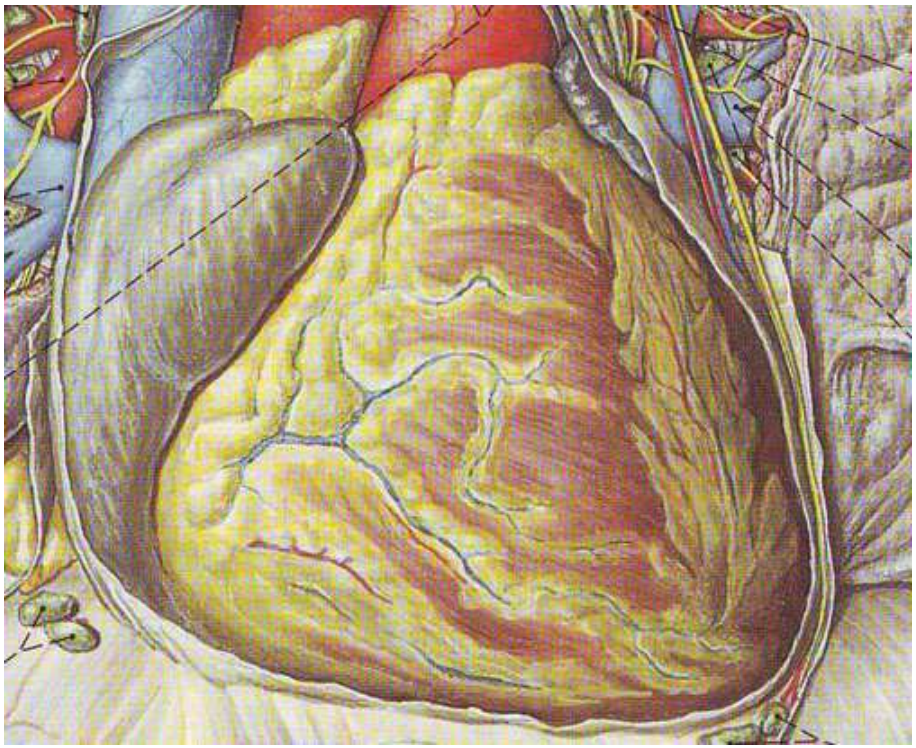
- *trigonum thymicum*
- *trigonum pericardiacum*



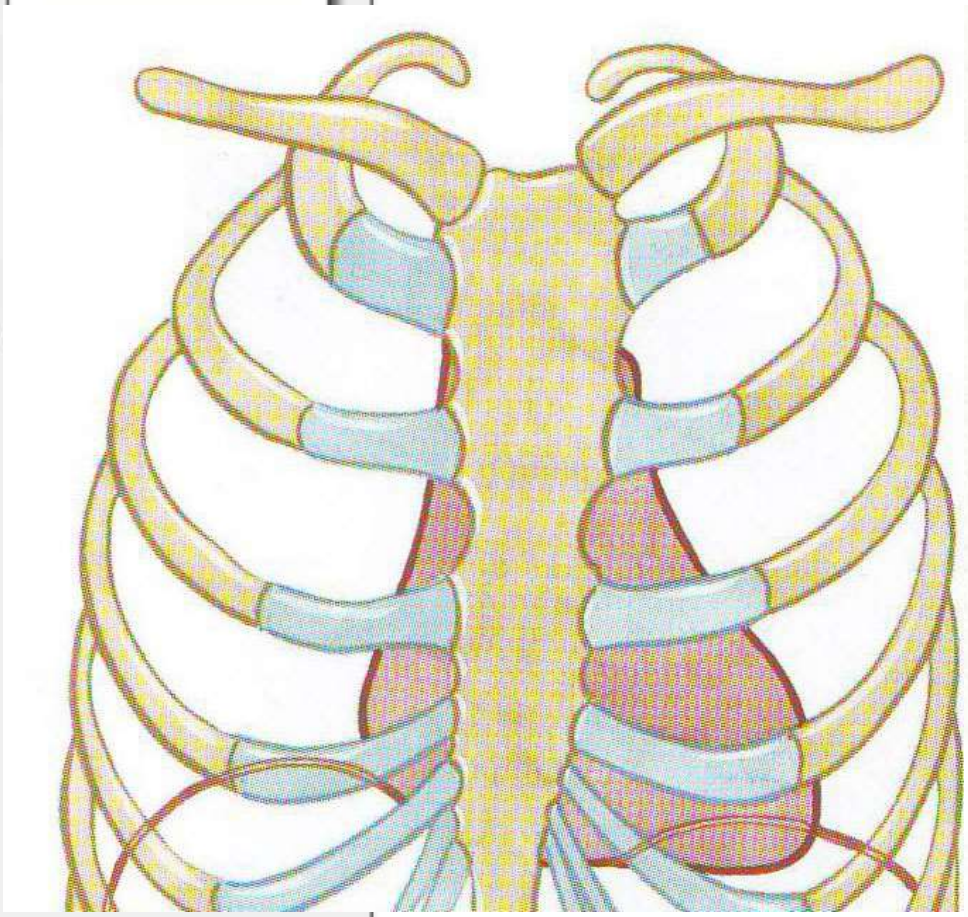


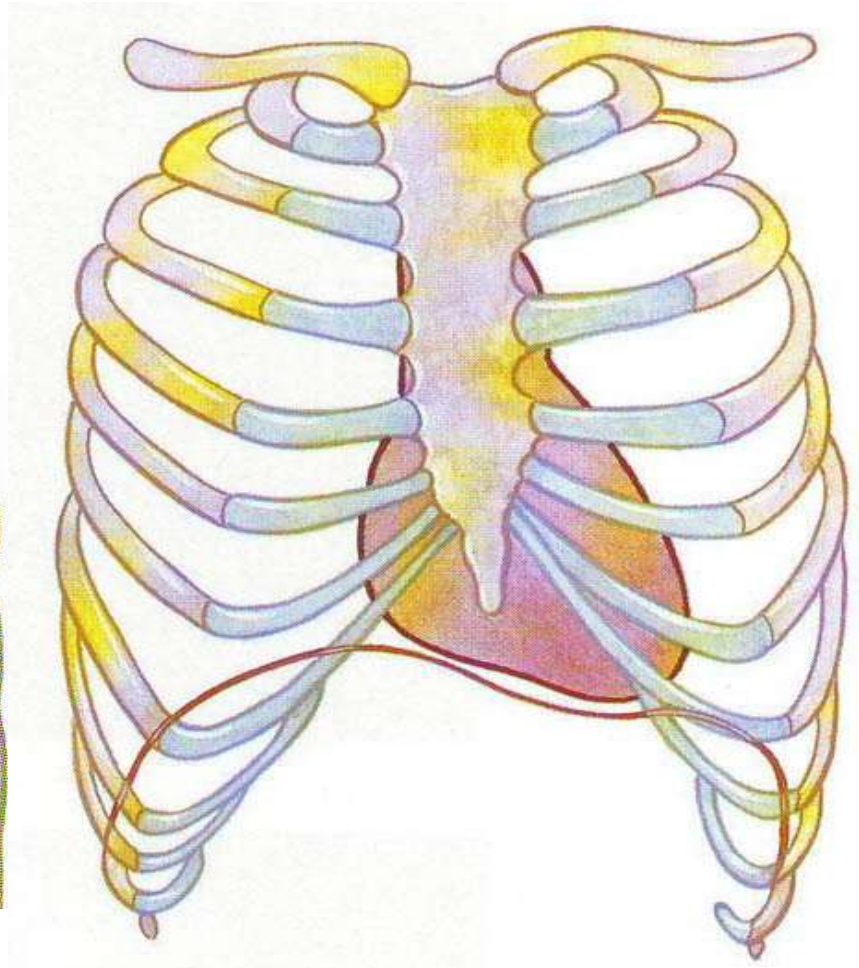
Middle mediastinum

- the broadest part of the interpleural space
- it contains:
  - ✓ the heart *(cor, cardia)*
  - ✓ the pericardium *(pericardium)*

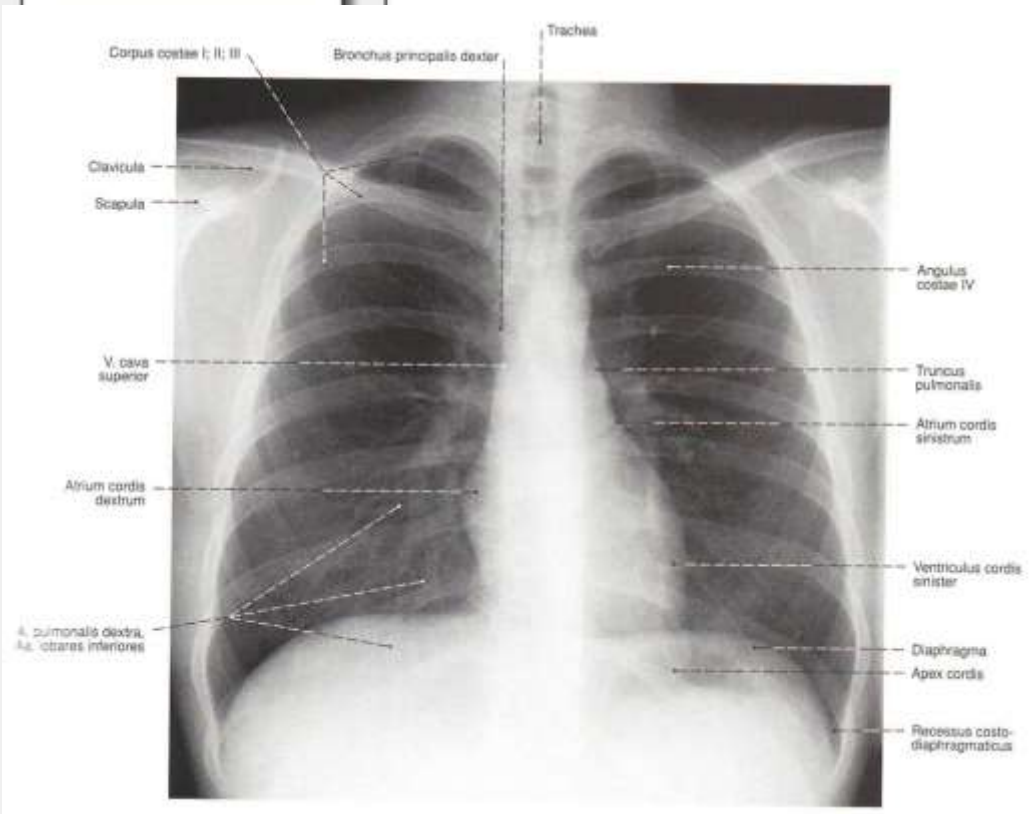


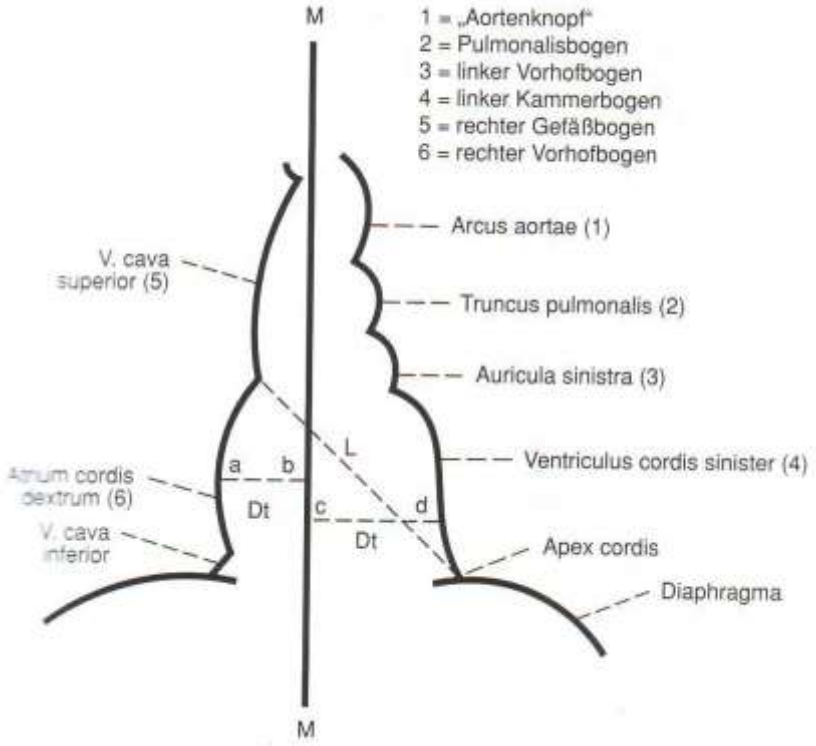
Heart skeletotopy



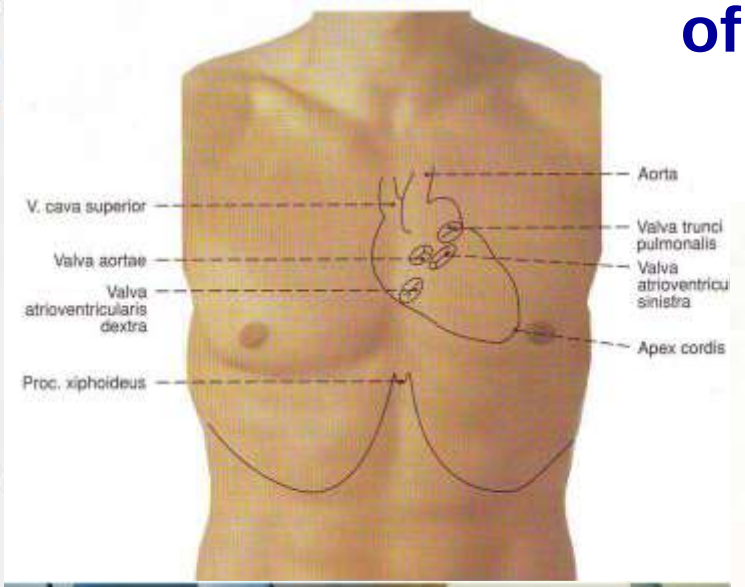


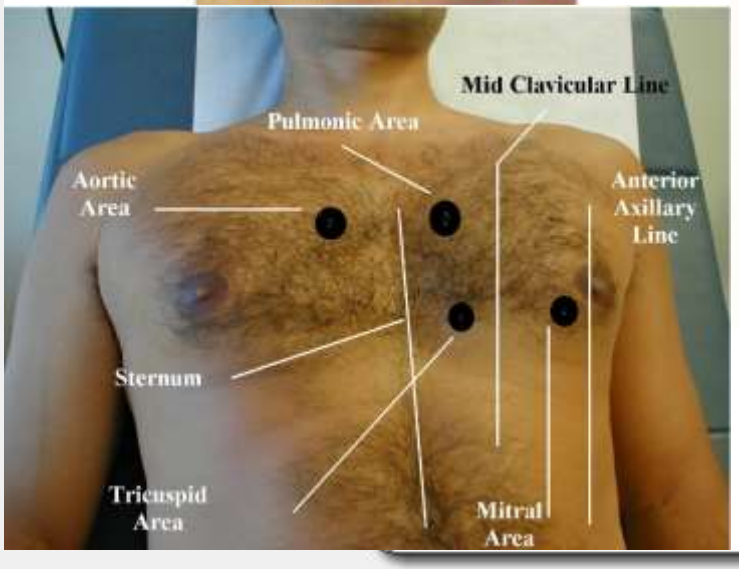
Heart X-ray

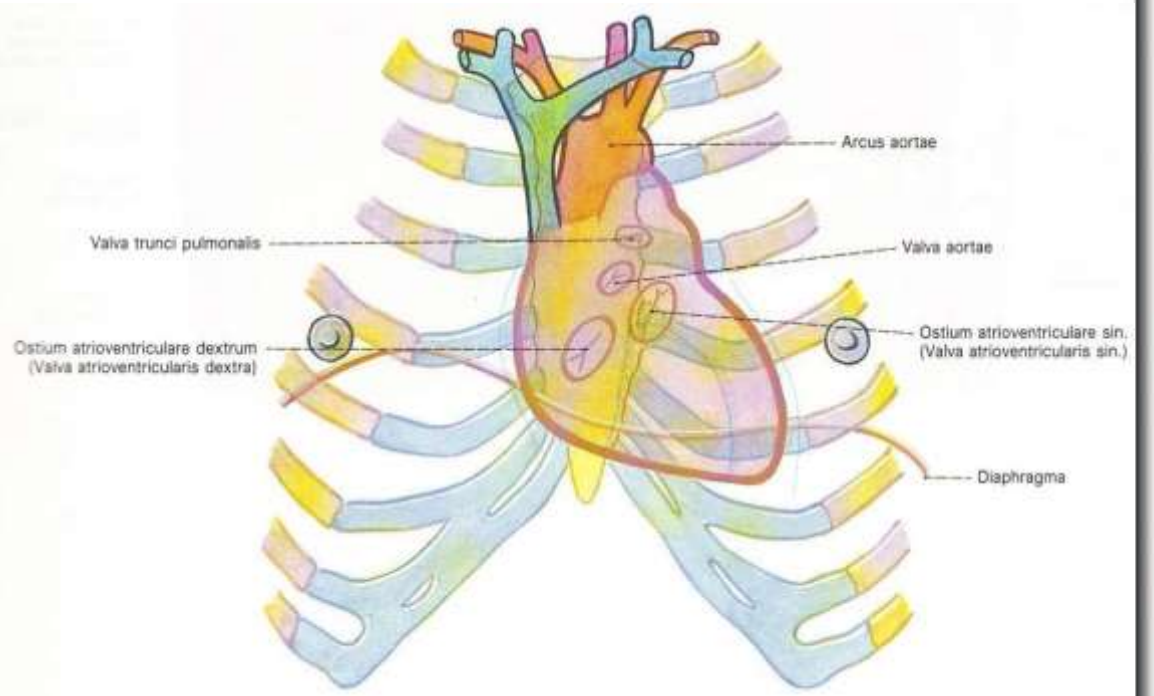

Corpus costae I; II; III
Bronchus principalis dexter
Trachea
Clavicula
Scapula
Angulus costae IV
V. cava superior
Truncus pulmonalis
Atrium cordis sinistrum
Atrium cordis dextrum
Ventriculus cordis sinister
A. pulmonalis dextra, Aa. lobares inferiores
Diaphragma
Apex cordis
Recessus costo-diaphragmaticus

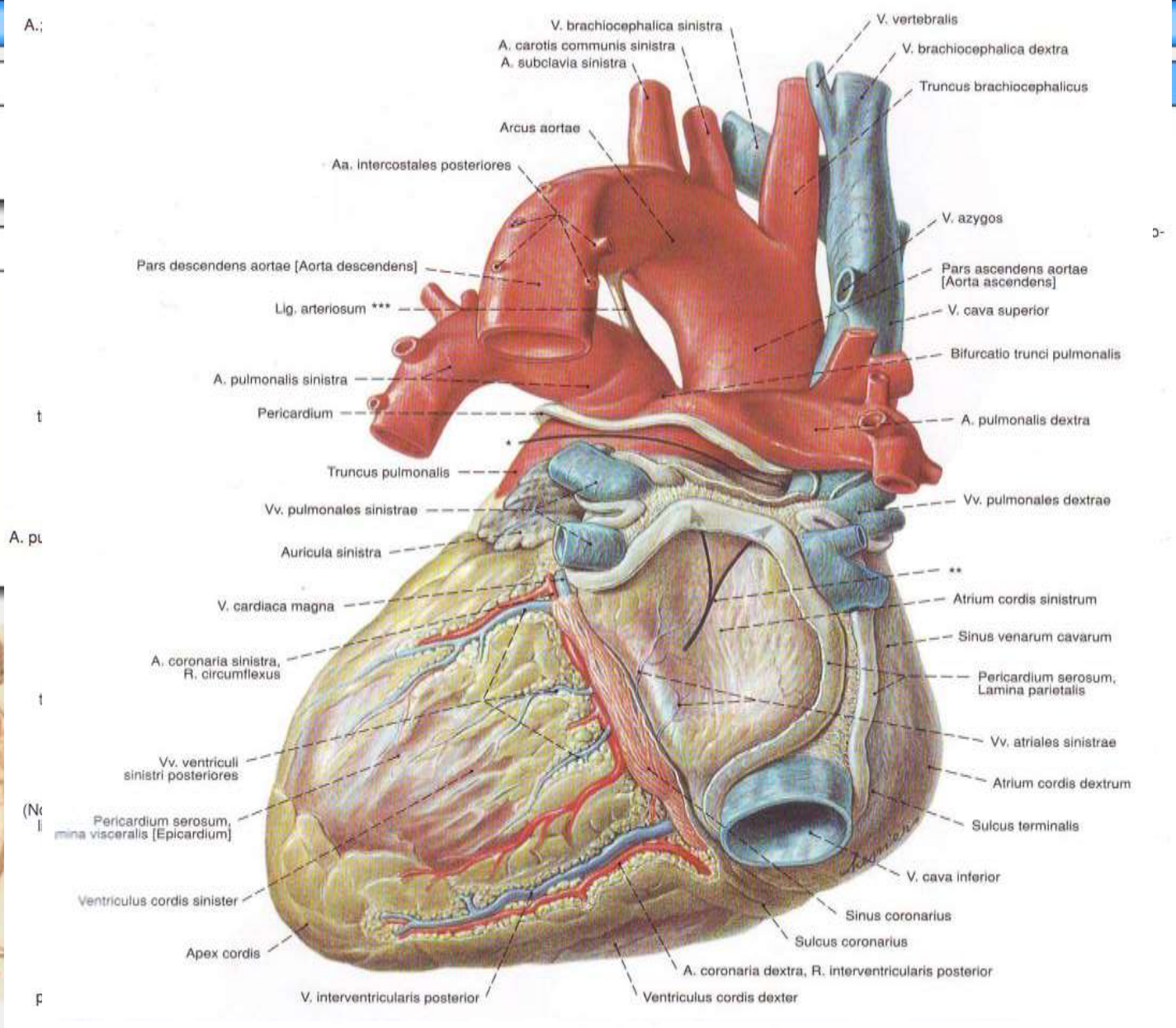

M
1 = „Aortenknopf"
2 = Pulmonalisbogen
3 = linker Vorhofbogen
4 = linker Kammerbogen
5 = rechter Gefäßbogen
6 = rechter Vorhofbogen
Arcus aortae (1)
V. cava superior (5)
Truncus pulmonalis (2)
Auricula sinistra (3)
Ventriculus cordis sinister (4)
Atrium cordis dextrum (6)
a
b
L
Dt
c
d
Dt
V. cava inferior
Apex cordis
Diaphragma
M

Places of projection and points of auscultation of heart valves on the thorax



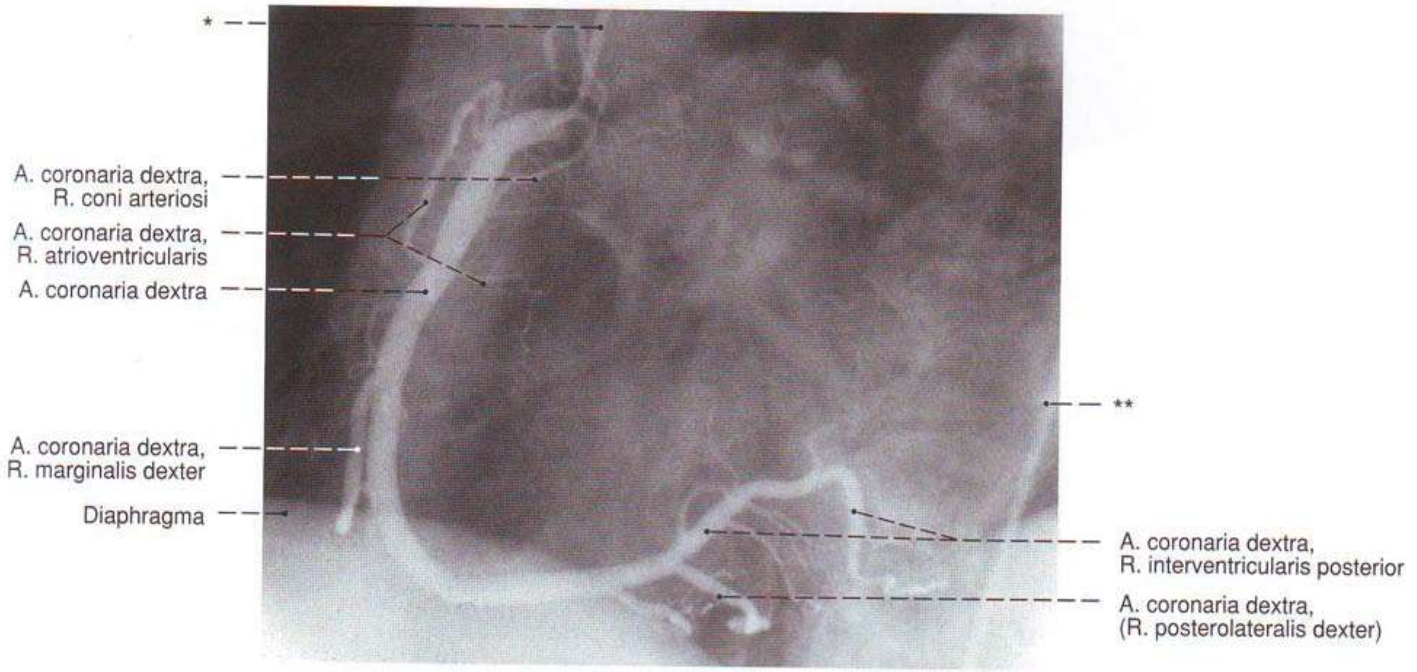






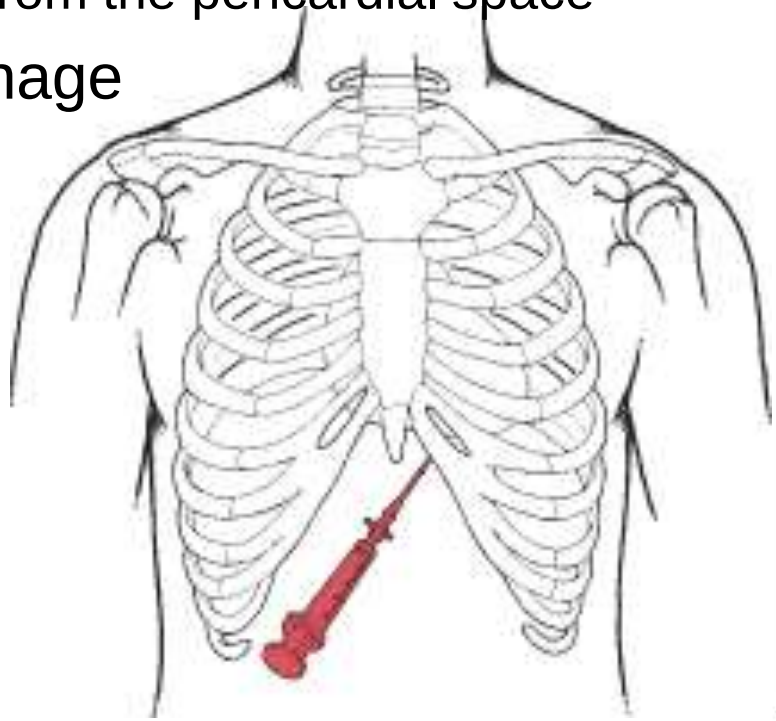
The heart vessels – clinical significance

- Coronary artery stenosis:
  - ✓ coronary angiography
  - ✓ coronary stents



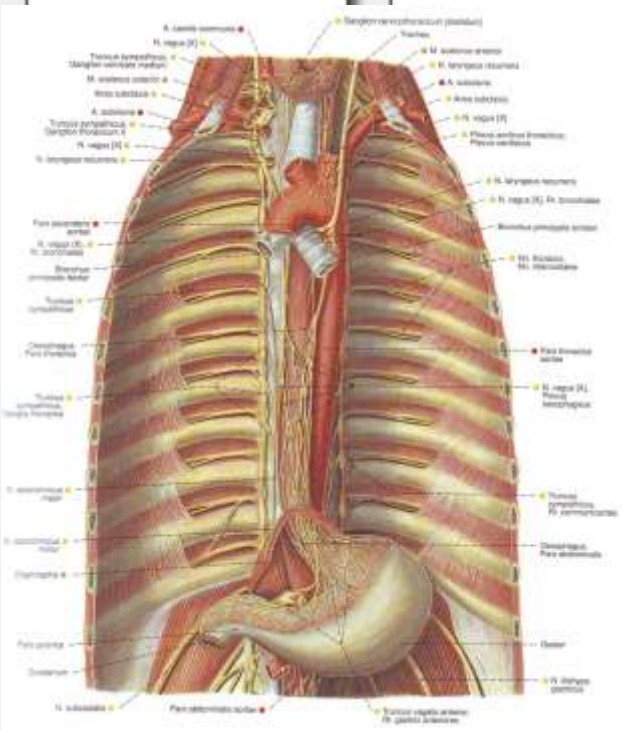
The pericardium – clinical significance

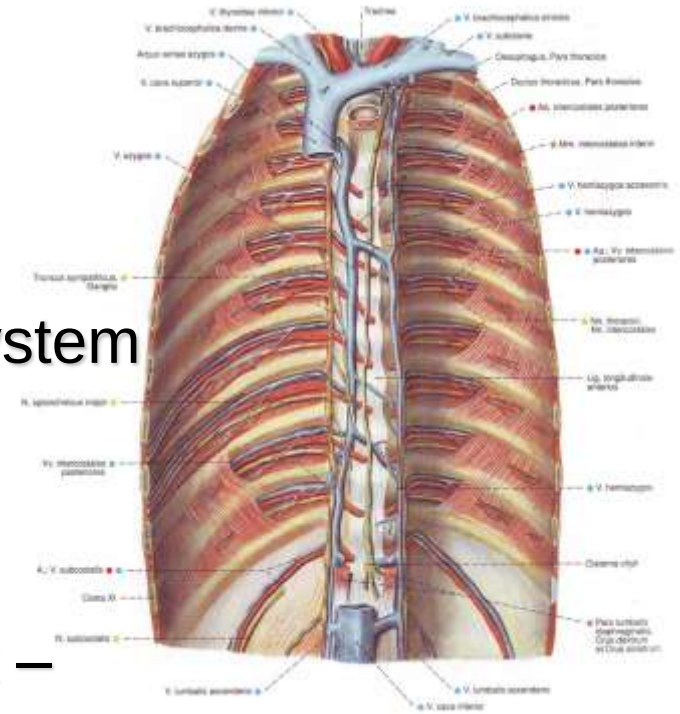
- Surgical treatment of pericarditis:
  - ✓ pericardiocentesis (life saving procedure) – the aspiration of fluid from the pericardial space
  - ✓ open surgical drainage
  - ✓ pericardiectomy



Posterior mediastinum

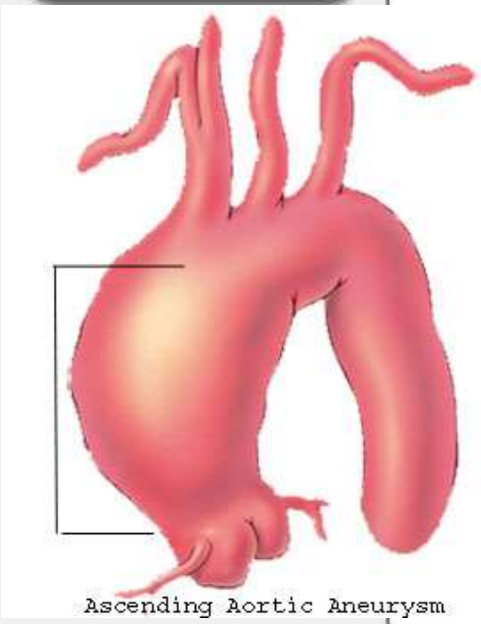
- ✓ Esophagus
- ✓ Thoracic aorts
- ✓ Vagus nerve
- ✓ Azygos venous system
- ✓ Thoracic duct – *ductus thoracicus*
- ✓ Sympathetic trunk – *truncus sympathicus*

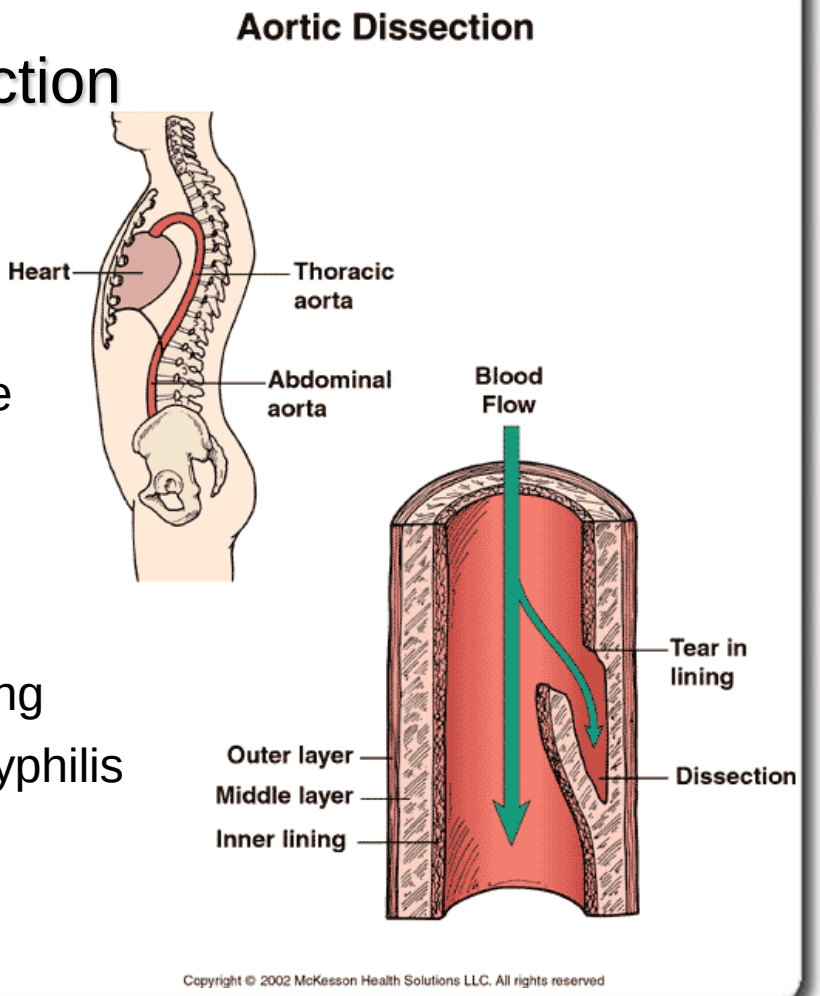


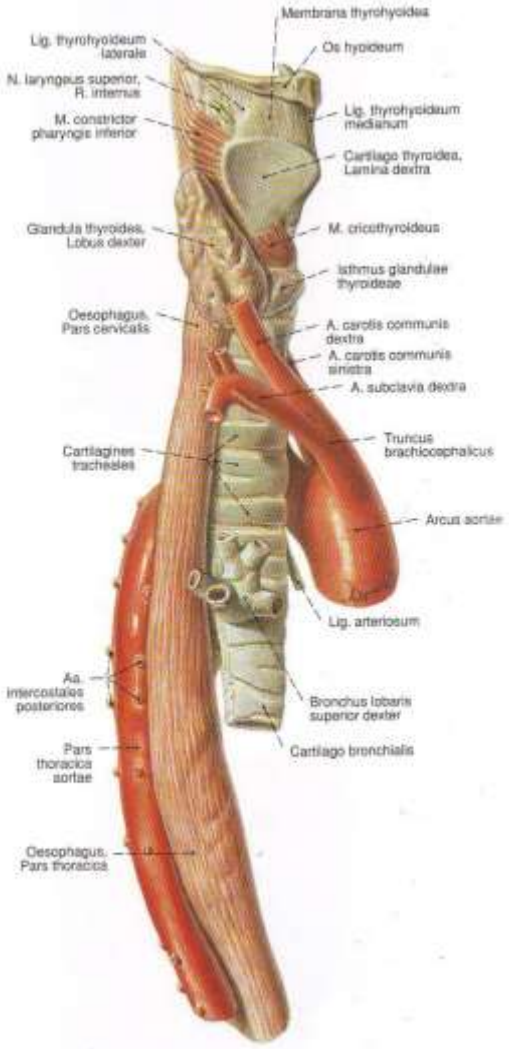


Large blood vessels – clinical significance

- Aneurysm and dissection of the thoracic aorta:
  - ✓ more often affect its descending part
  - ✓ the most common cause – atherosclerosis
  - ✓ some other factors: congenital syndromes (*S. Marfan*), long-standing hypertension, trauma, syphilis



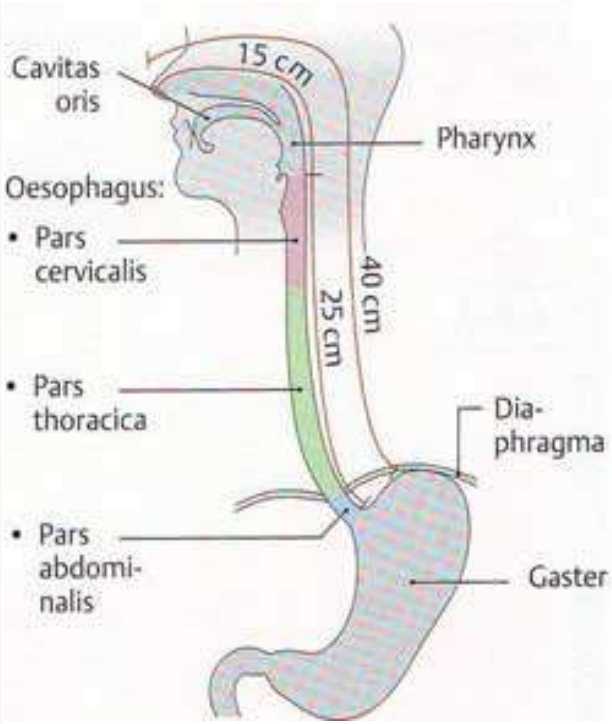


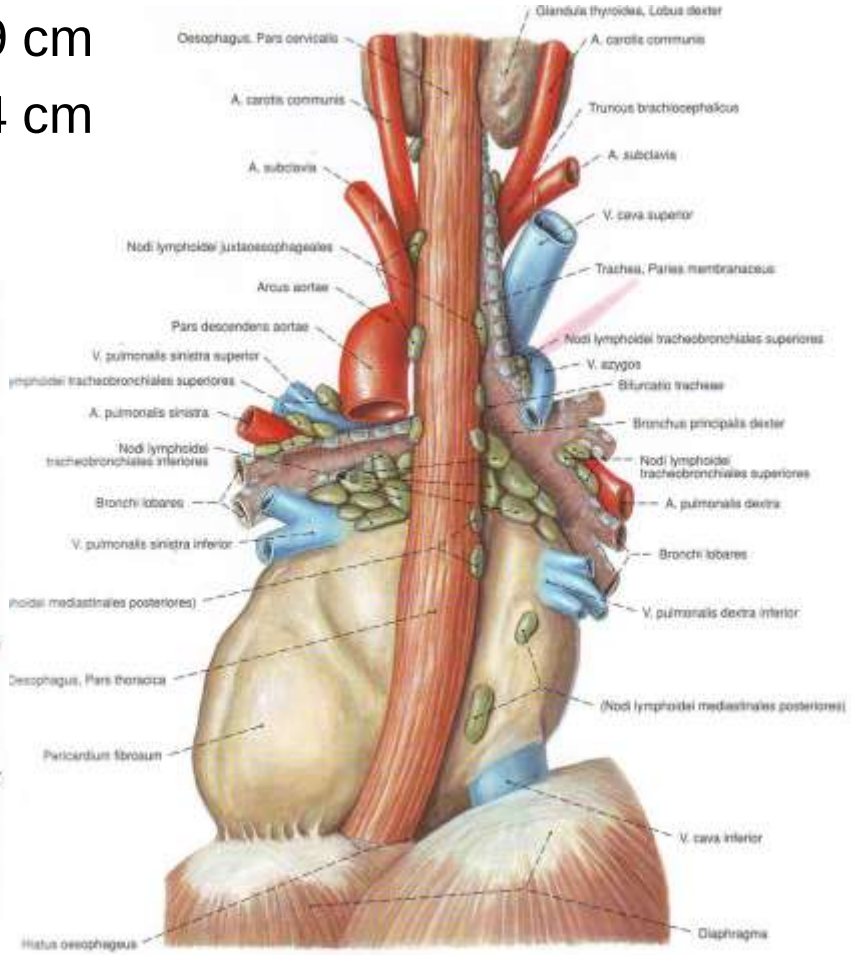


Esophagus (*Esophagus*)

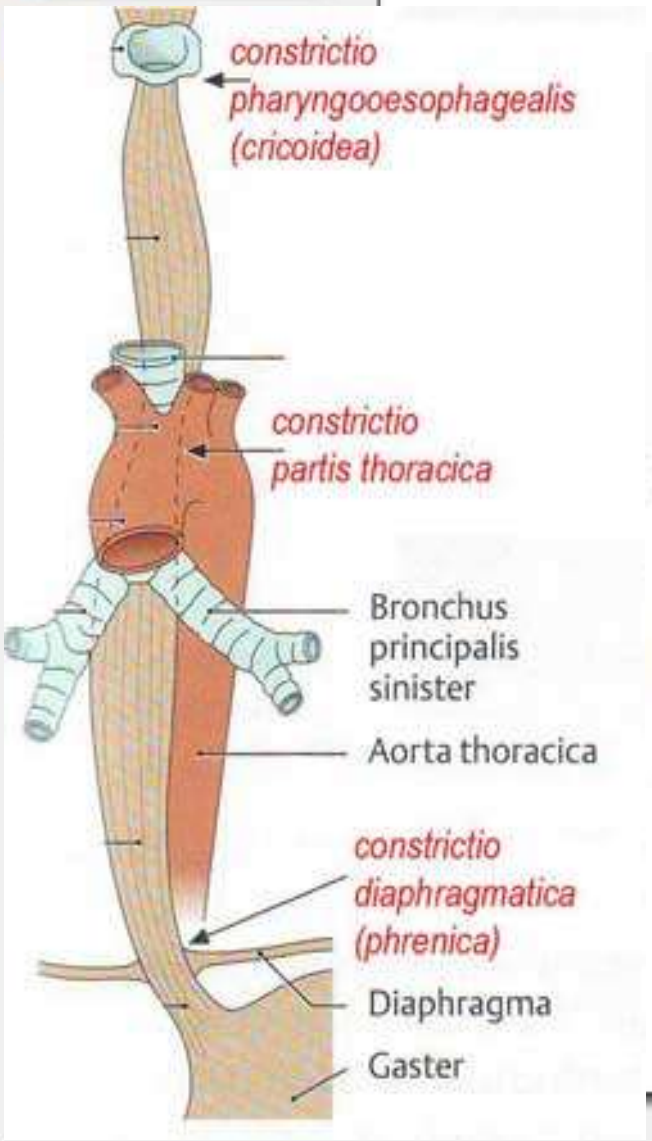
Topographi anatomy

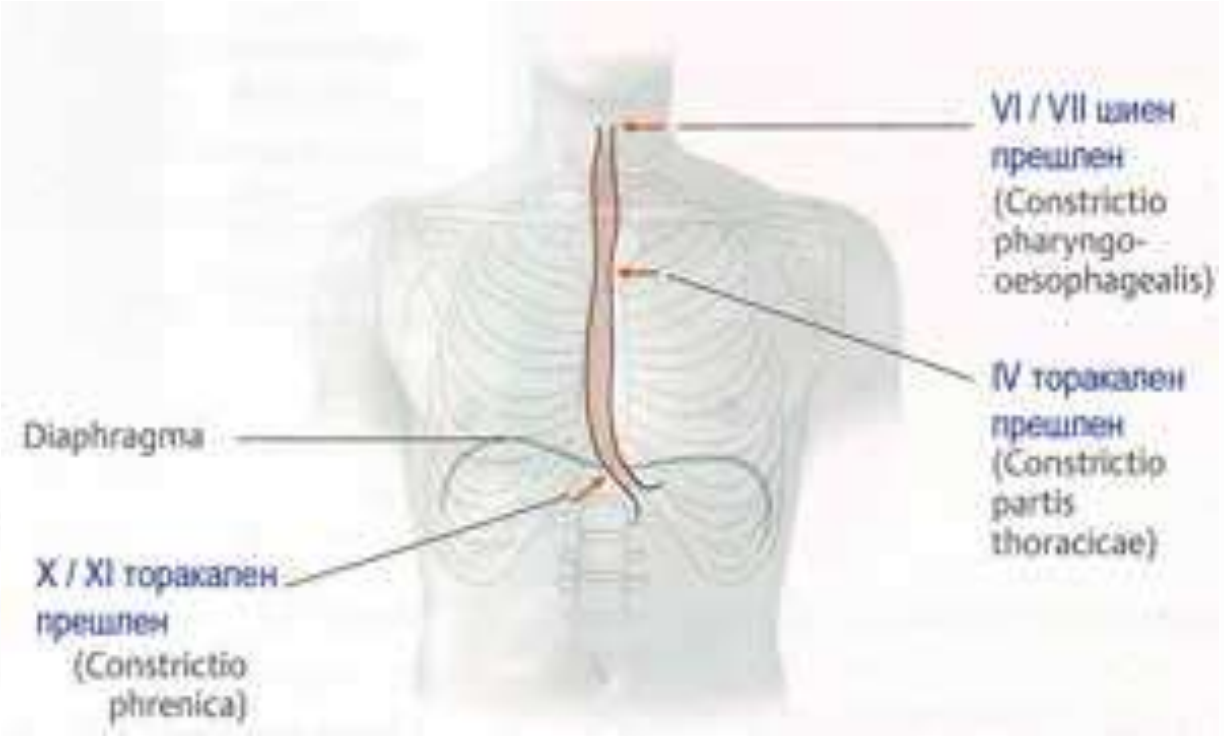
- **cervical part** – 5-6 cm
- **thoracic part** – 16-19 cm
- **abdominal part** – 1-4 cm





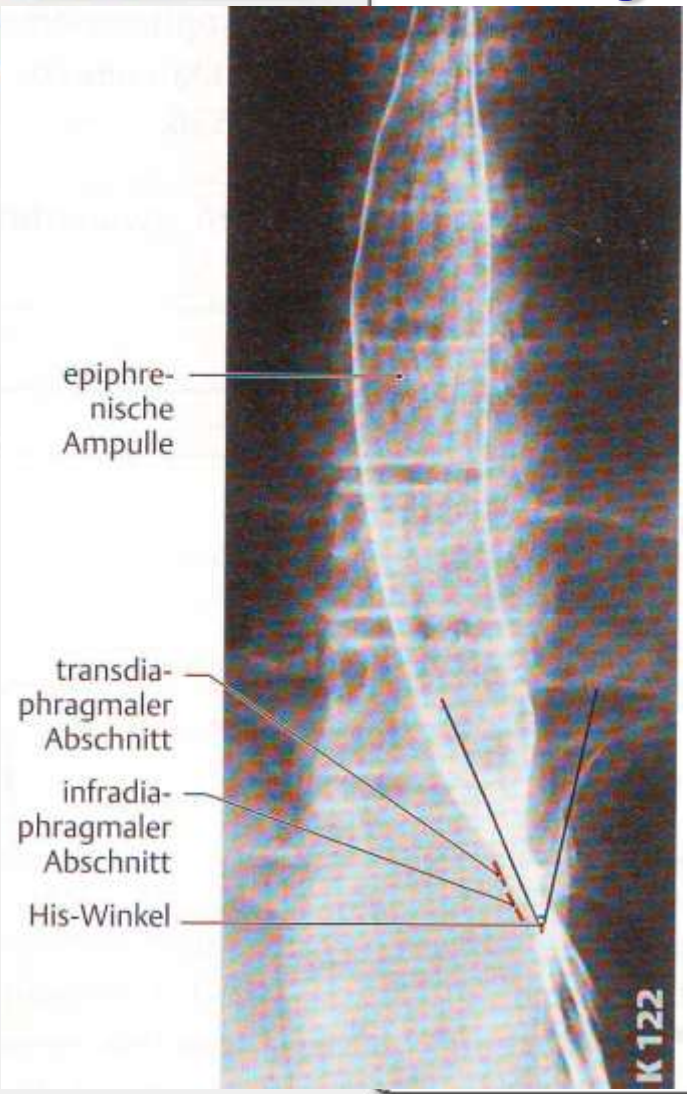
Anatomical constrictions





The **pharyngeal constriction** is at 15 cm from the upper incisor teeth – *important in esophageal and gastric inspection with endoscopy!*

Physiological constrictions

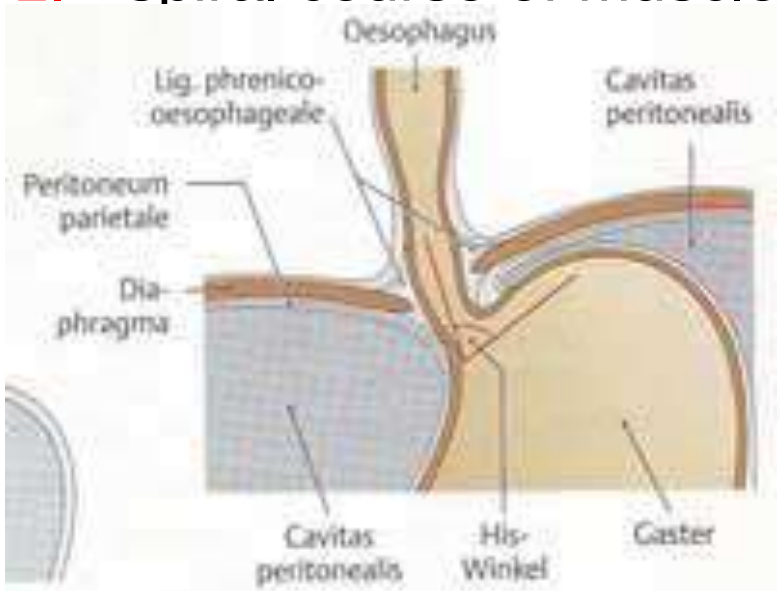


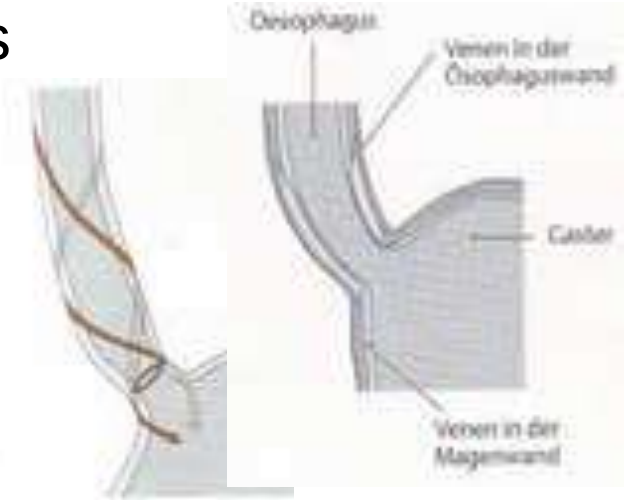
Due to the contraction of esophageal musculature:

1. **Aortic** – at the level of the **aortic arch** at Th 4–5
2. **Cardiac** – before opening the esophagus in the stomach

Closing mechanism

1. spiral course of muscles

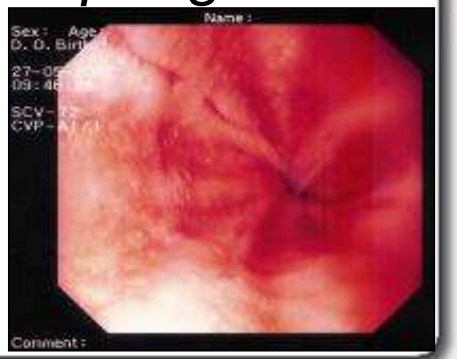




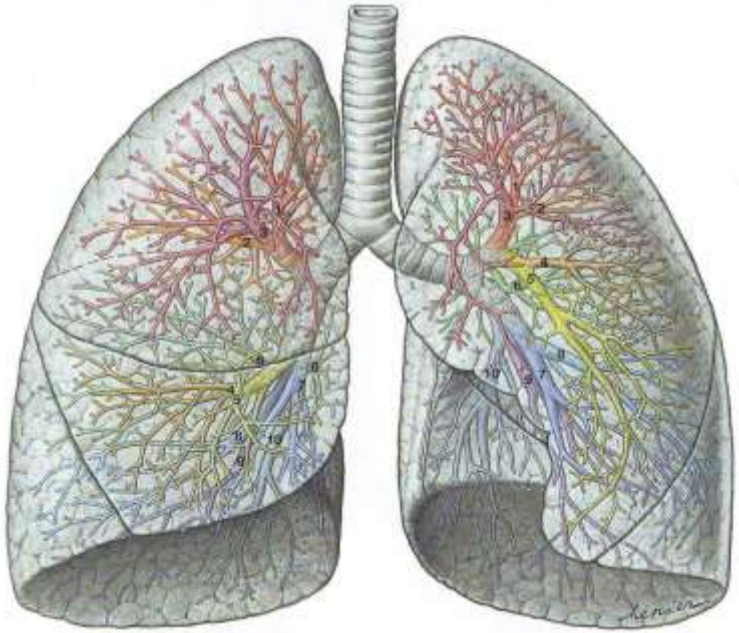
2. venous plexus

3. elastic fixation via *lig. phrenicooesophageale*

4. pressure difference between thoracic and abdominal cavity

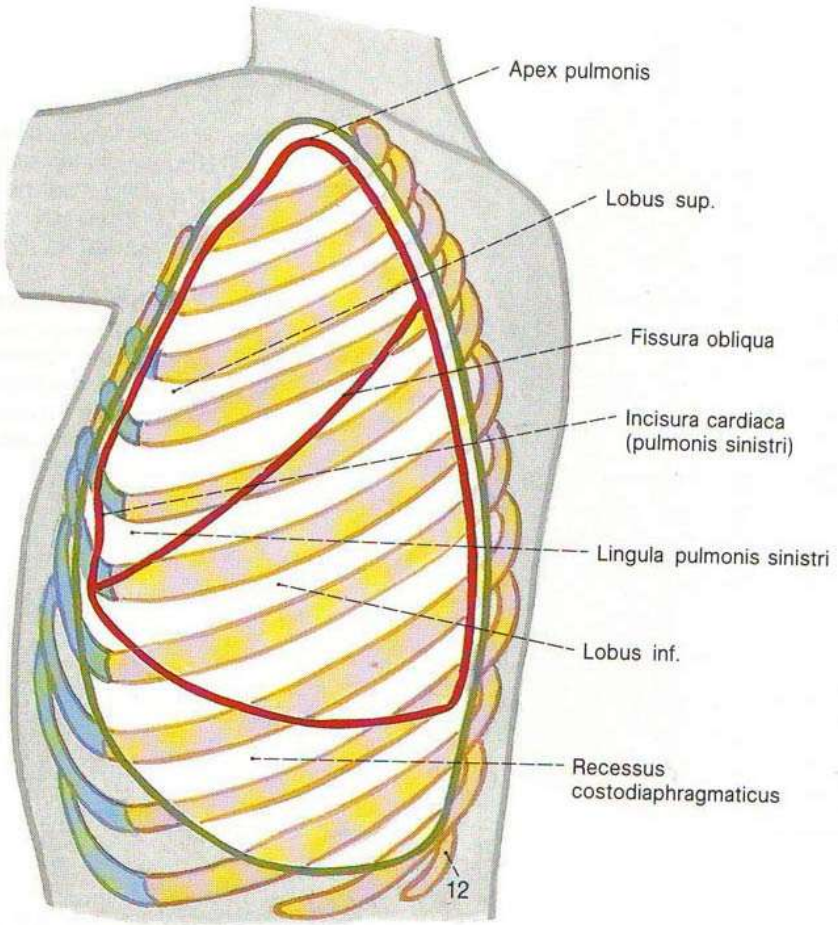


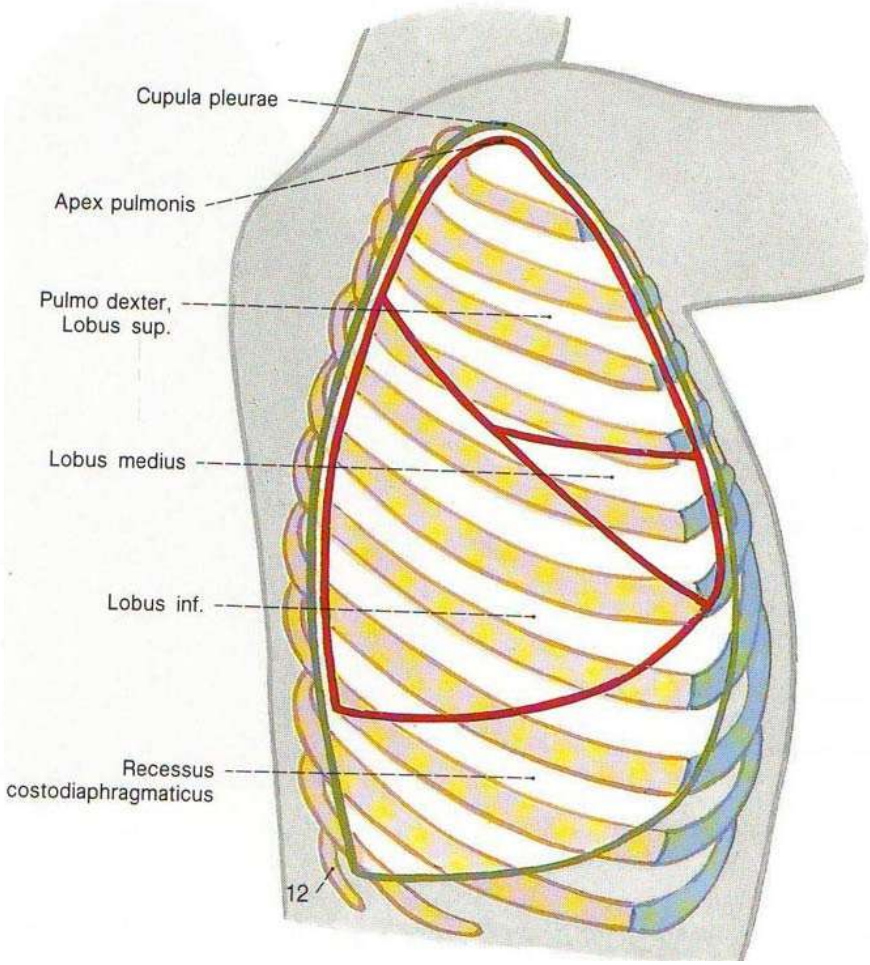
***Clinical significance**: insufficiency of the closing mechanism – reflux of gastric juice ⇨ esophagitis*



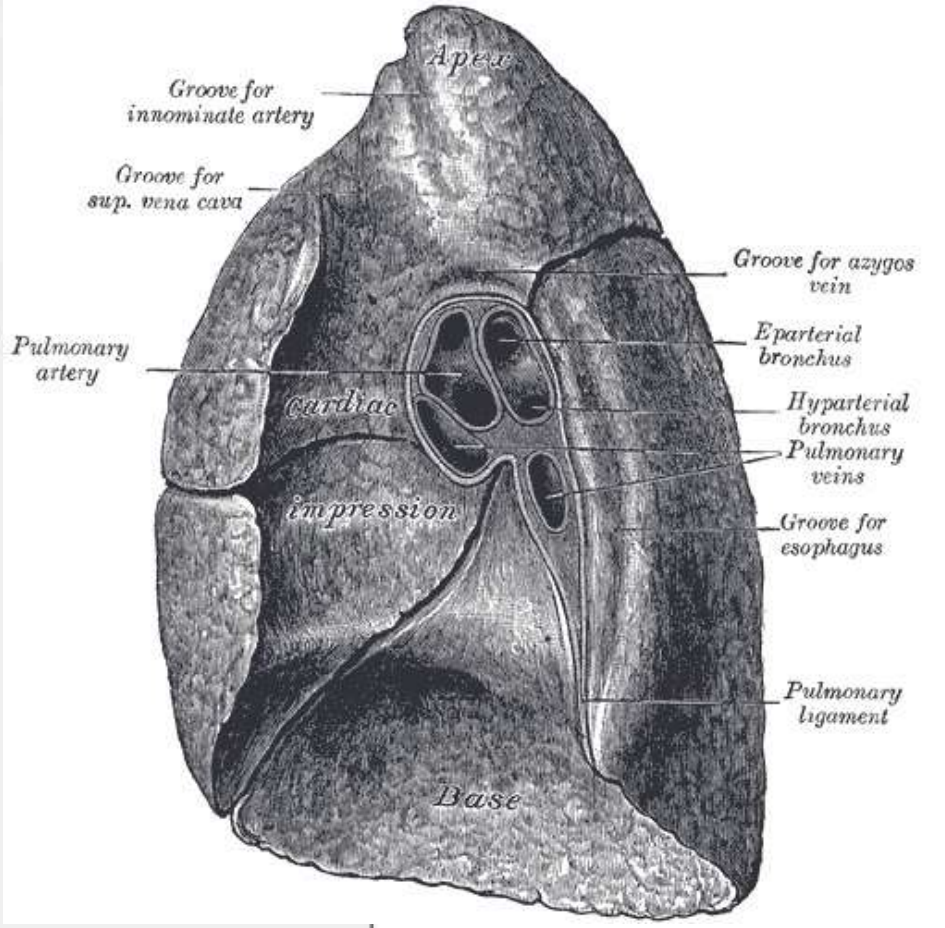
The Lung *(Pulmo)*

Lung lobes

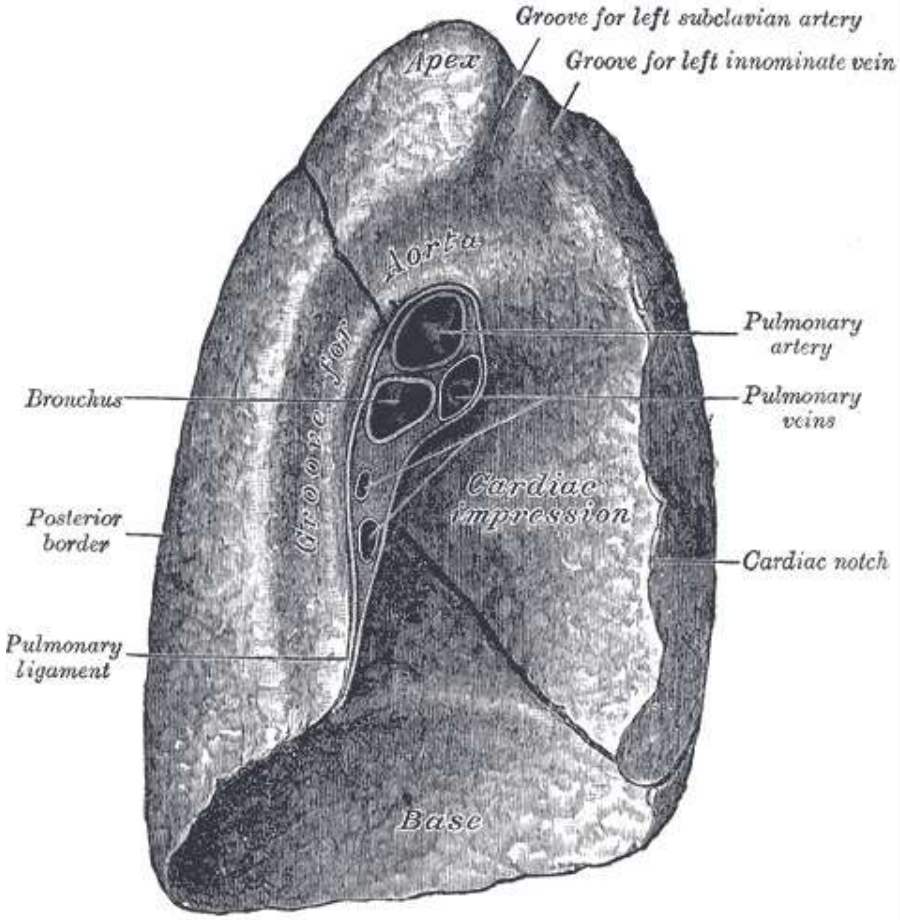

Apex pulmonis
Lobus sup.
Fissura obliqua
Incisura cardiaca
(pulmonis sinistri)
Lingula pulmonis sinistri
Lobus inf.
Recessus
costodiaphragmaticus
12


Cupula pleurae
Apex pulmonis
Pulmo dexter,
Lobus sup.
Lobus medius
Lobus inf.
Recessus
costodiaphragmaticus
12

The root of the lung – topographic relationships

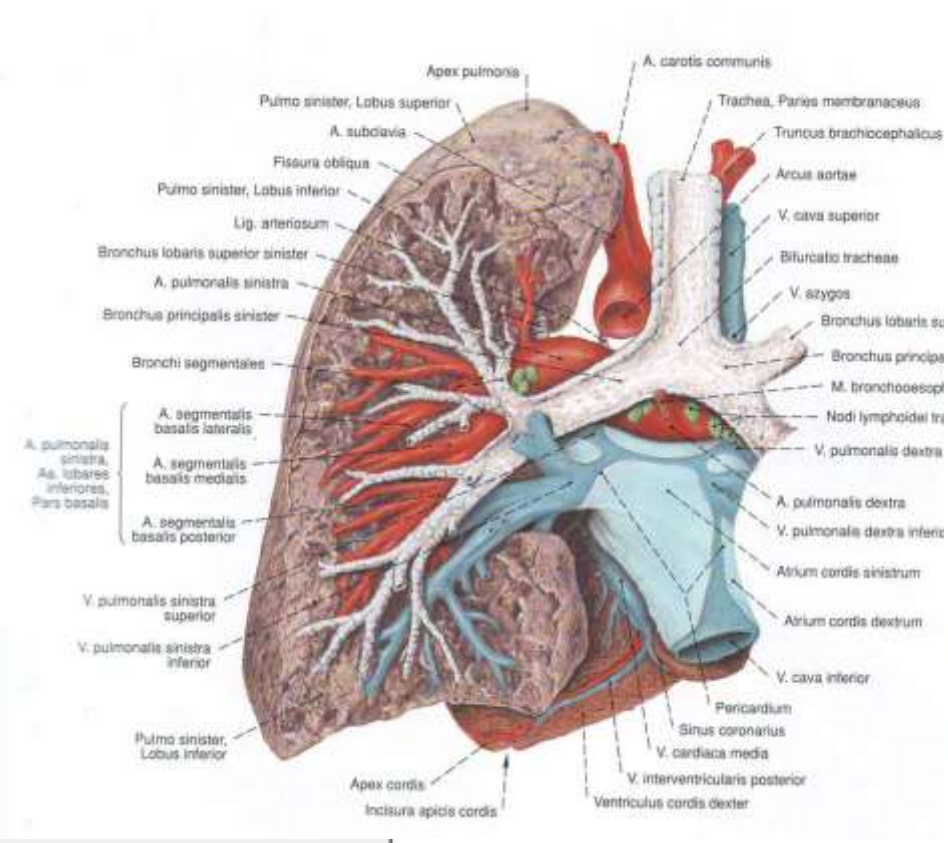


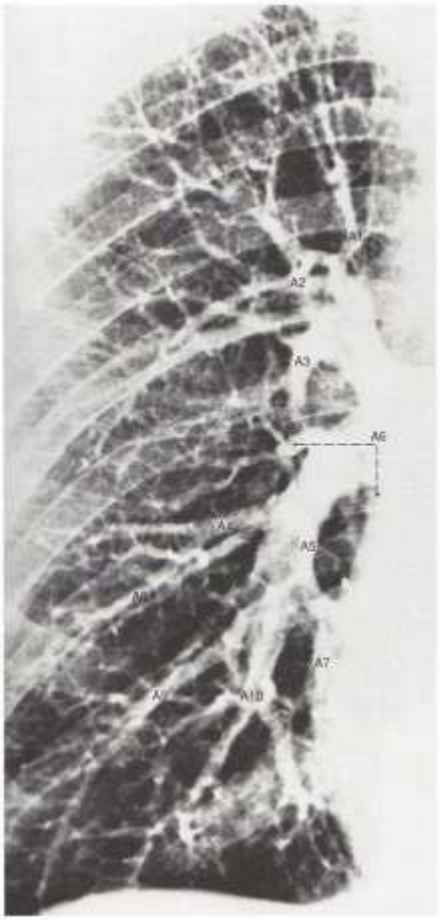
Right: bronchus-artery-veins (BAV)

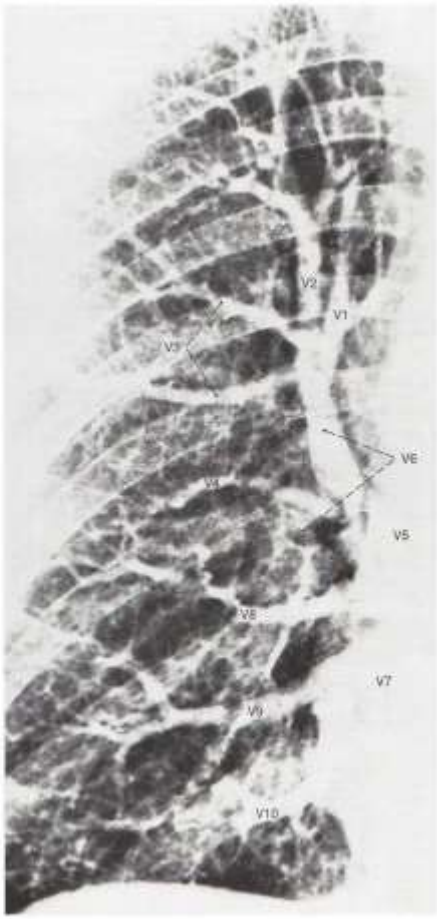


Left: artery-bronchus-veins (ABV)

Chest X-ray

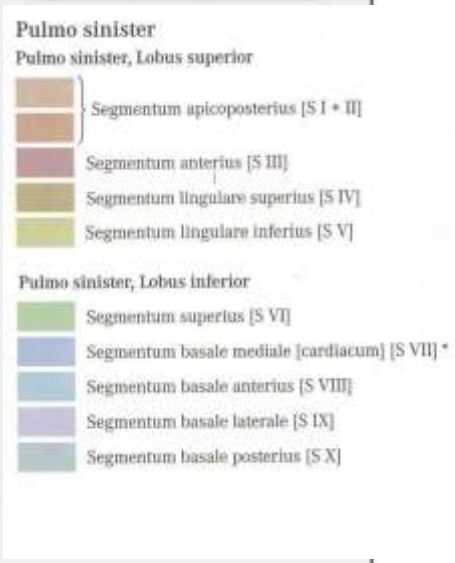

Apex pulmonis
Pulmo sinister, Lobus superior
A. subclavia
Fissura obliqua
Pulmo sinister, Lobus inferior
Lig. arteriosum
Bronchus lobaris superior sinister
A. pulmonalis sinistra
Bronchus principalis sinister
Bronchi segmentales
A. pulmonalis sinistra, Aa. lobares inferiores, Pars basalis
A. segmentalis basalis lateralis
A. segmentalis basalis medialis
A. segmentalis basalis posterior
V. pulmonalis sinistra superior
V. pulmonalis sinistra inferior
Pulmo sinister, Lobus inferior
Apex cordis
Incisura apicis cordis
A. carotis communis
Trachea, Paries membranaceus
Truncus brachiocephalicus
Arcus aortae
V. cava superior
Bifurcatio trachaeae
V. azygos
Bronchus lobaris su
Bronchus principa
M. bronchooesopl
Nodi lymphoidei tr
V. pulmonalis dextra
A. pulmonalis dextra
V. pulmonalis dextra inferi
Atrium cordis sinistrum
Atrium cordis dextrum
V. cava inferior
Pericardium
Sinus coronarius
V. cardiaca media
V. interventricularis posterior
Ventriculus cordis dexter

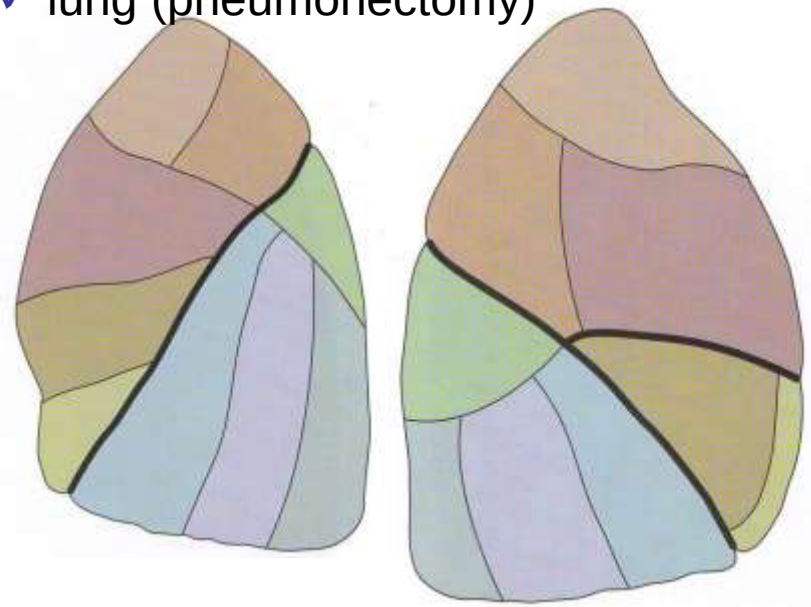

A1
A2
A3
A6
A5
A7
A10

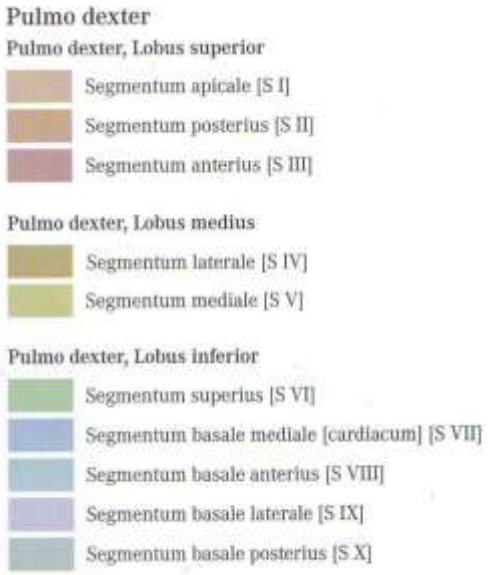

V2
V1
V3
V6
V5
V8
V7
V9
V10

Bronchopulmonary segments

- information on interpretation of radiographs
- surgical resection (removal) of:
  - ✓ segment (segmentectomy)
  - ✓ lobe (lobectomy)
  - ✓ lung (pneumonectomy)

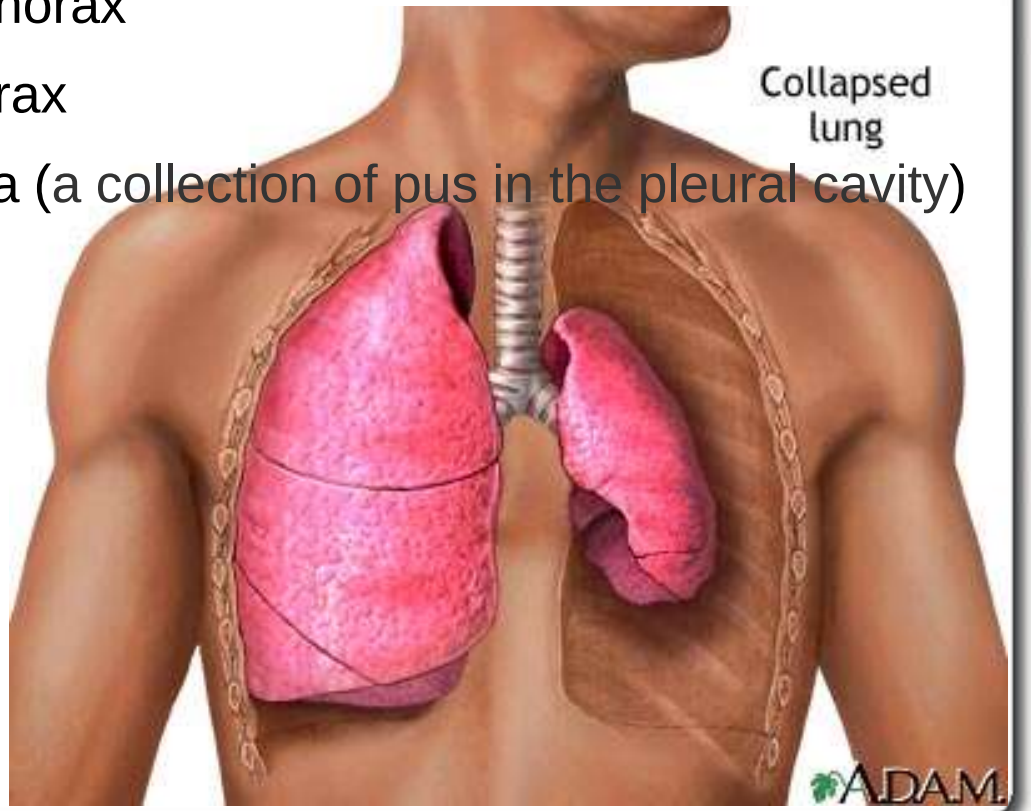


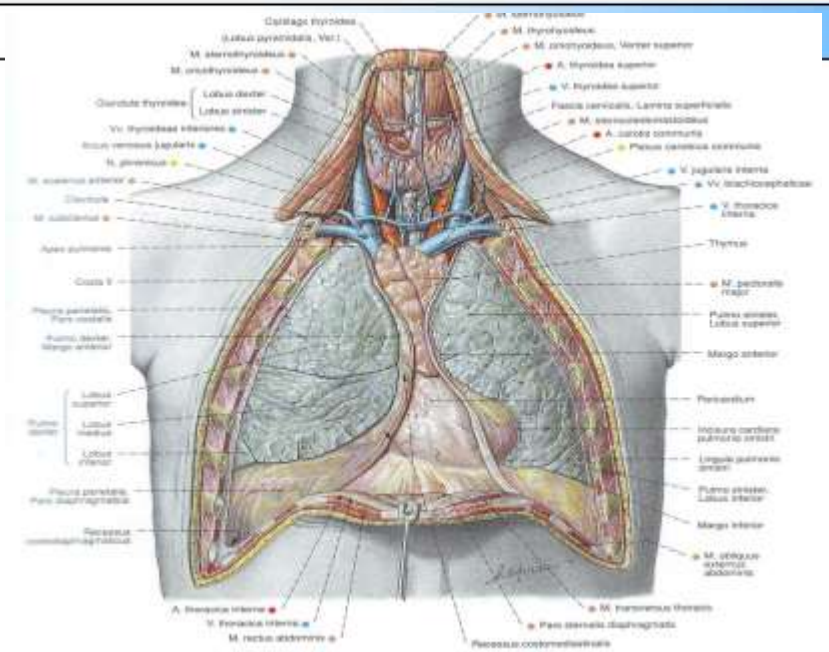




Clinical significance

- Lower than atmospheric pressure :
  - ✓ easy invasion of air, blood or exudate:
    - pneumothorax
    - hemothorax
    - empyema (a collection of pus in the pleural cavity)

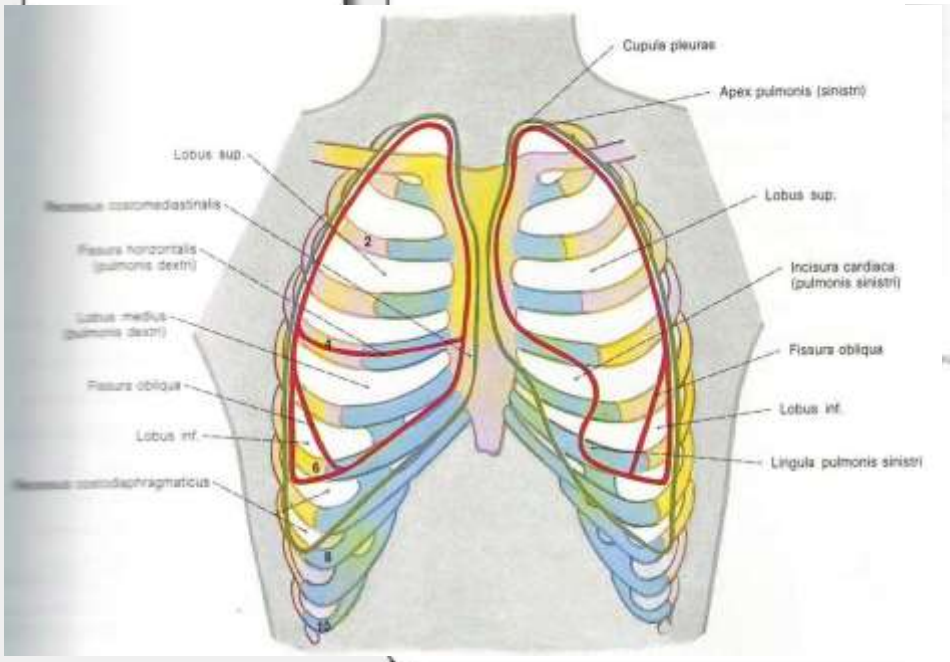


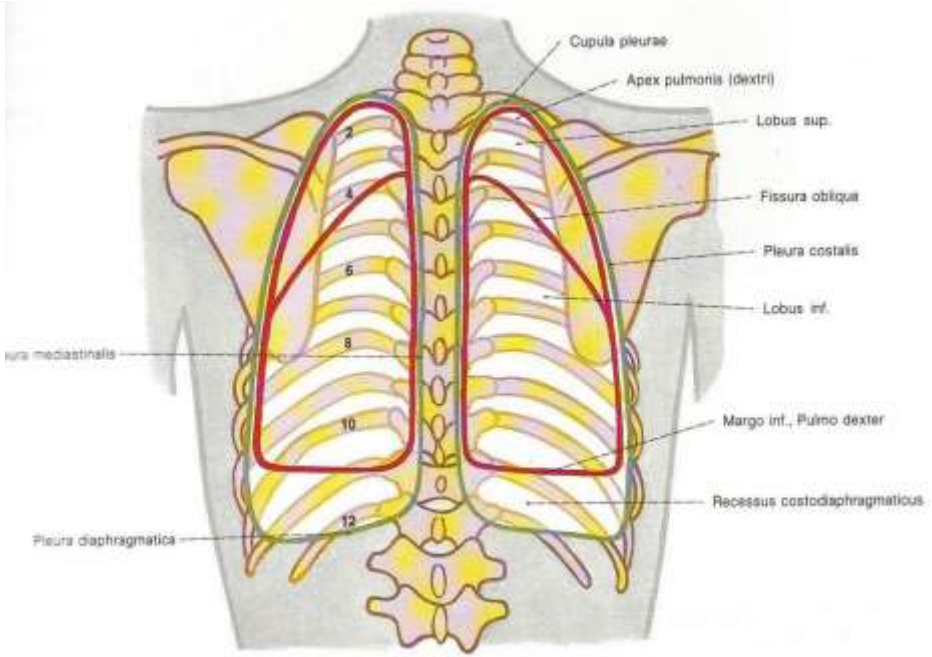


Pleura *(pleura)*

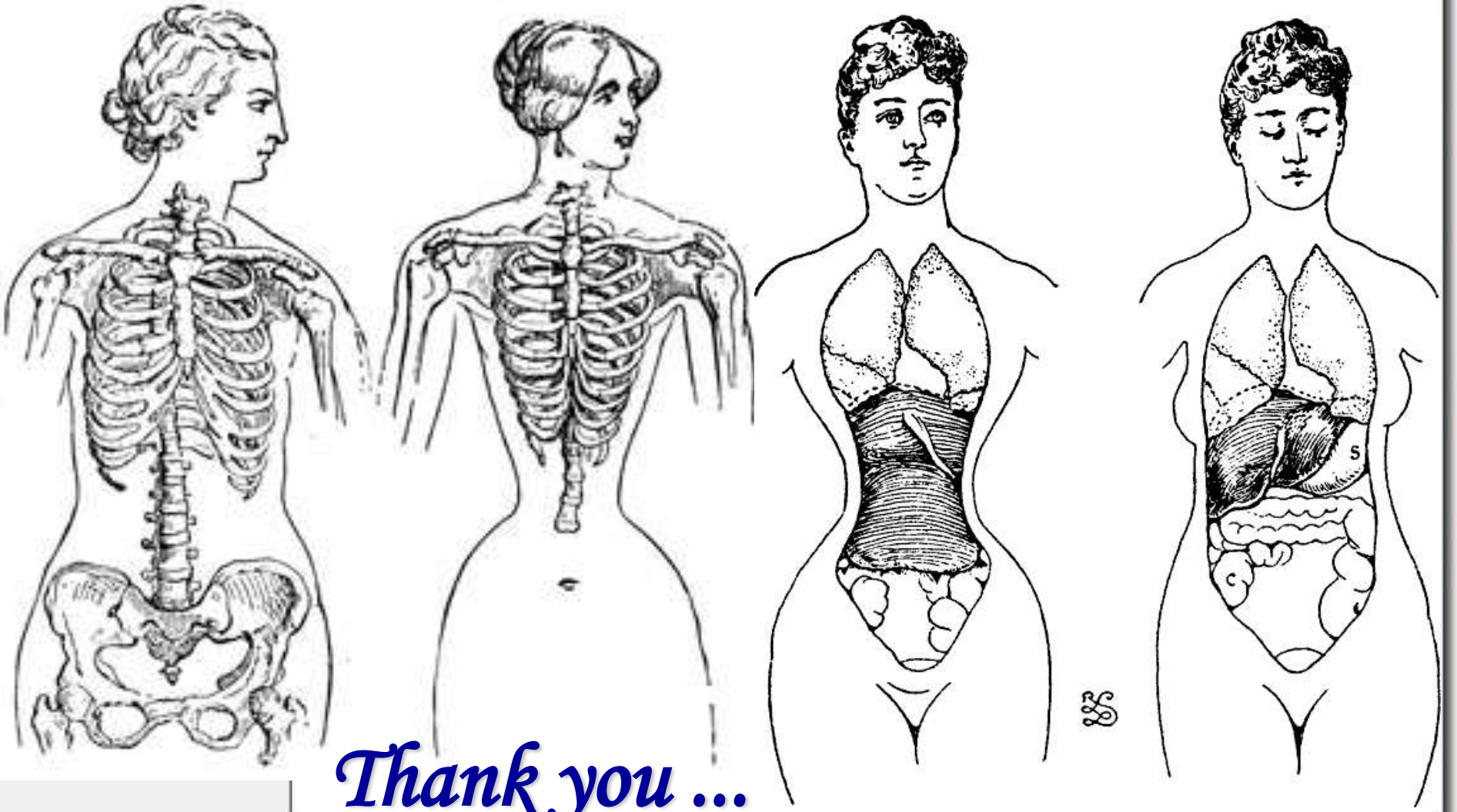
Lung and pleura skeletotopy

- anterior border – ride on even ribs II, IV and VI
- Inferior border – different for the lung and pleura: pleural sinuses ⇨ respiratory mobility
- posterior border – coincides for lung and pleura





Variation in the chest shape and situs



Thank you ...