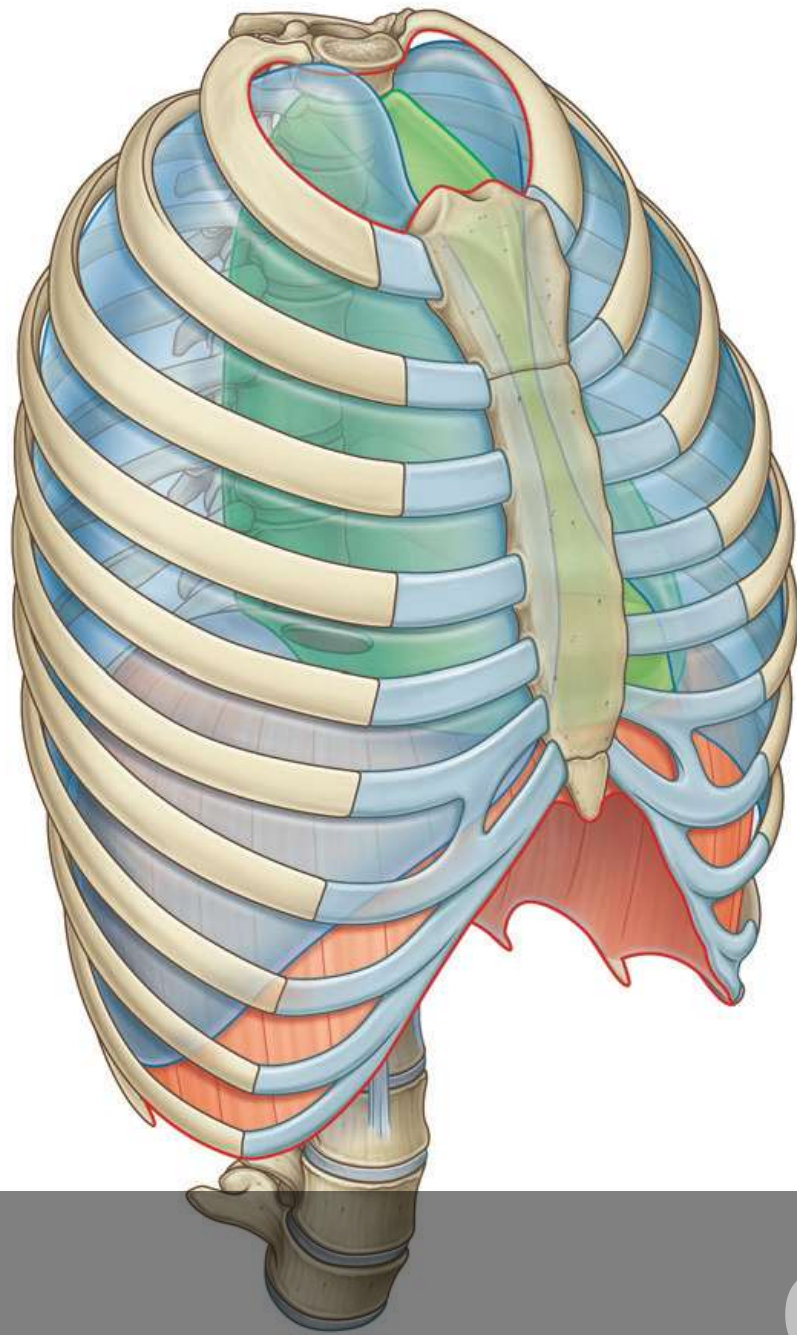


Thorax

Prof. MUDr. Jiří Ferda, Ph.D.

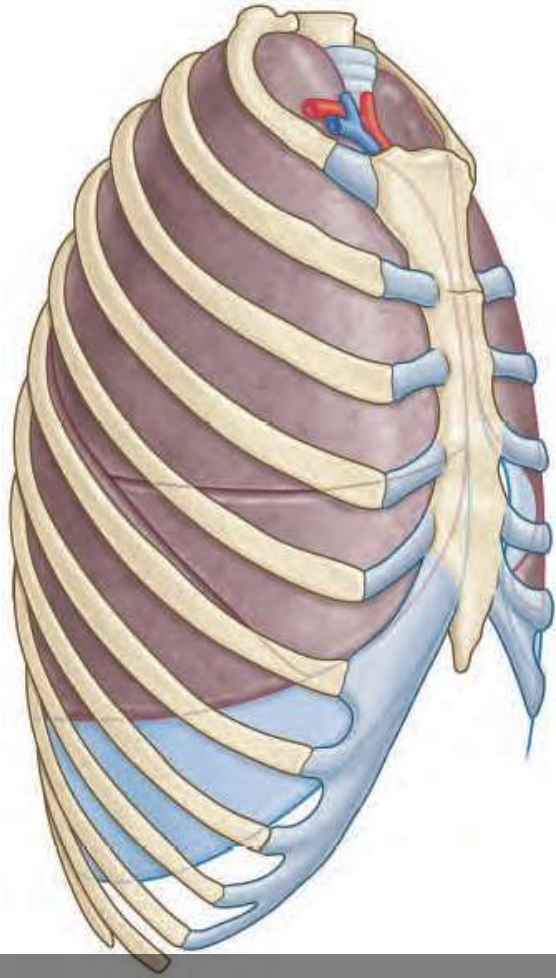
Thorax – chest wall, chest cavity, mediastinum

Prof. MUDr. Jiří Ferda, Ph.D.

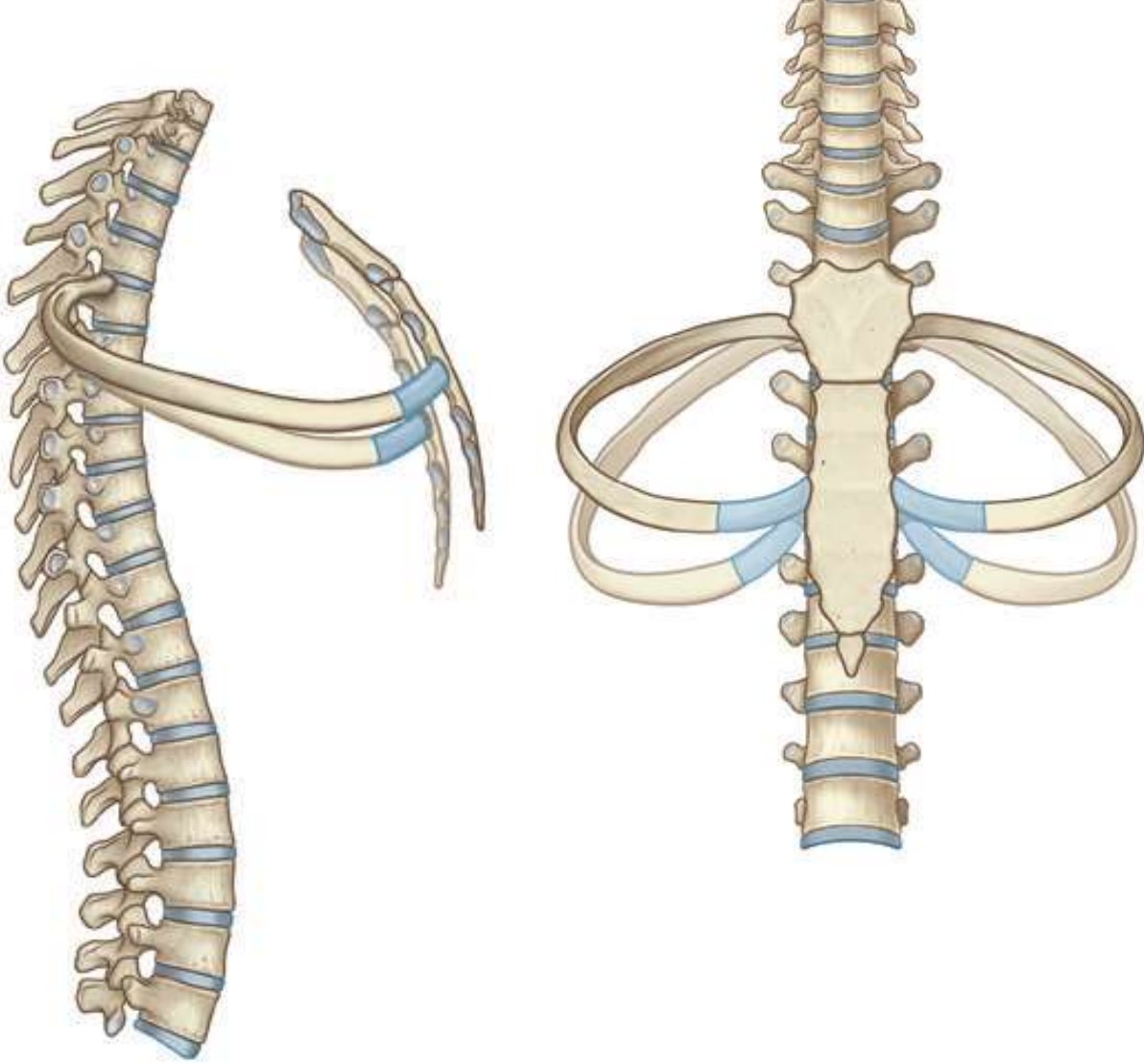


- ♦ **Upper margin of Th1 – 1st rib - manubrium st.**
 - ♦ Apertura thoracica superior
 - ♦ Continuation of neck
- ♦ **Lower margin - diaphragm**
 - ♦ Apertura thoracica inferior
 - ♦ Continuation to abdominal cavity - hiatus
- ♦ **Outer margins**
 - ♦ Muskuloskeletal wall
 - ♦ Vertebral column, ribs, sternum, muscles
 - ♦ Flexible, moveable

CHEST

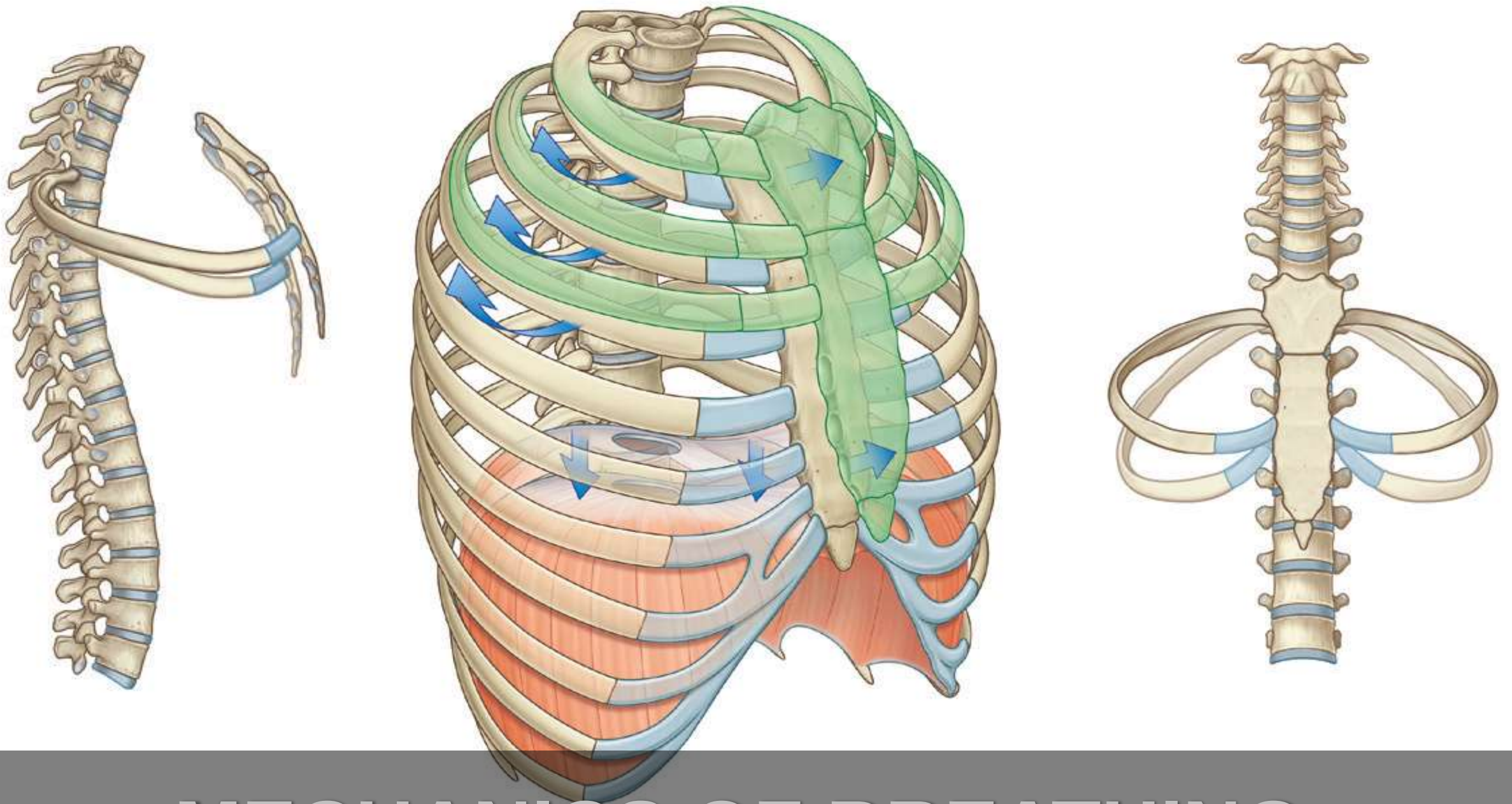


CHEST



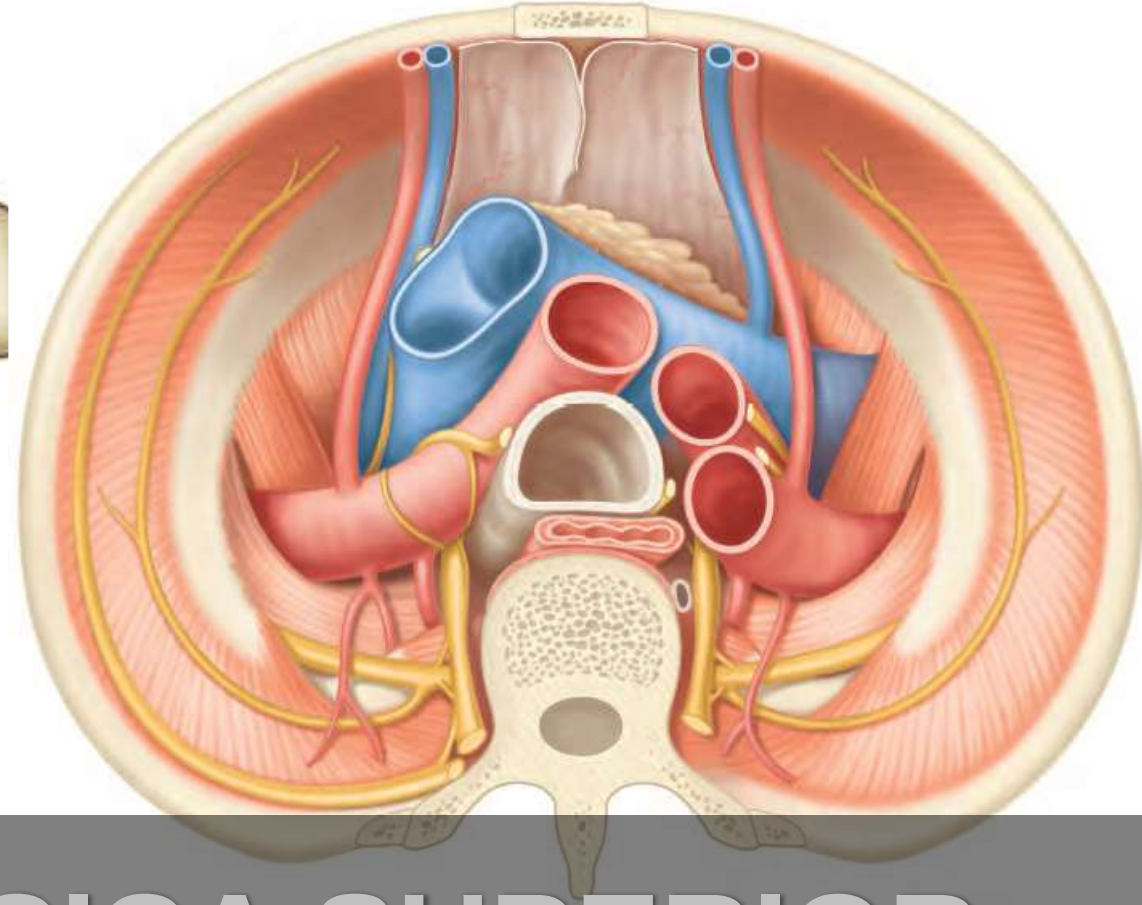
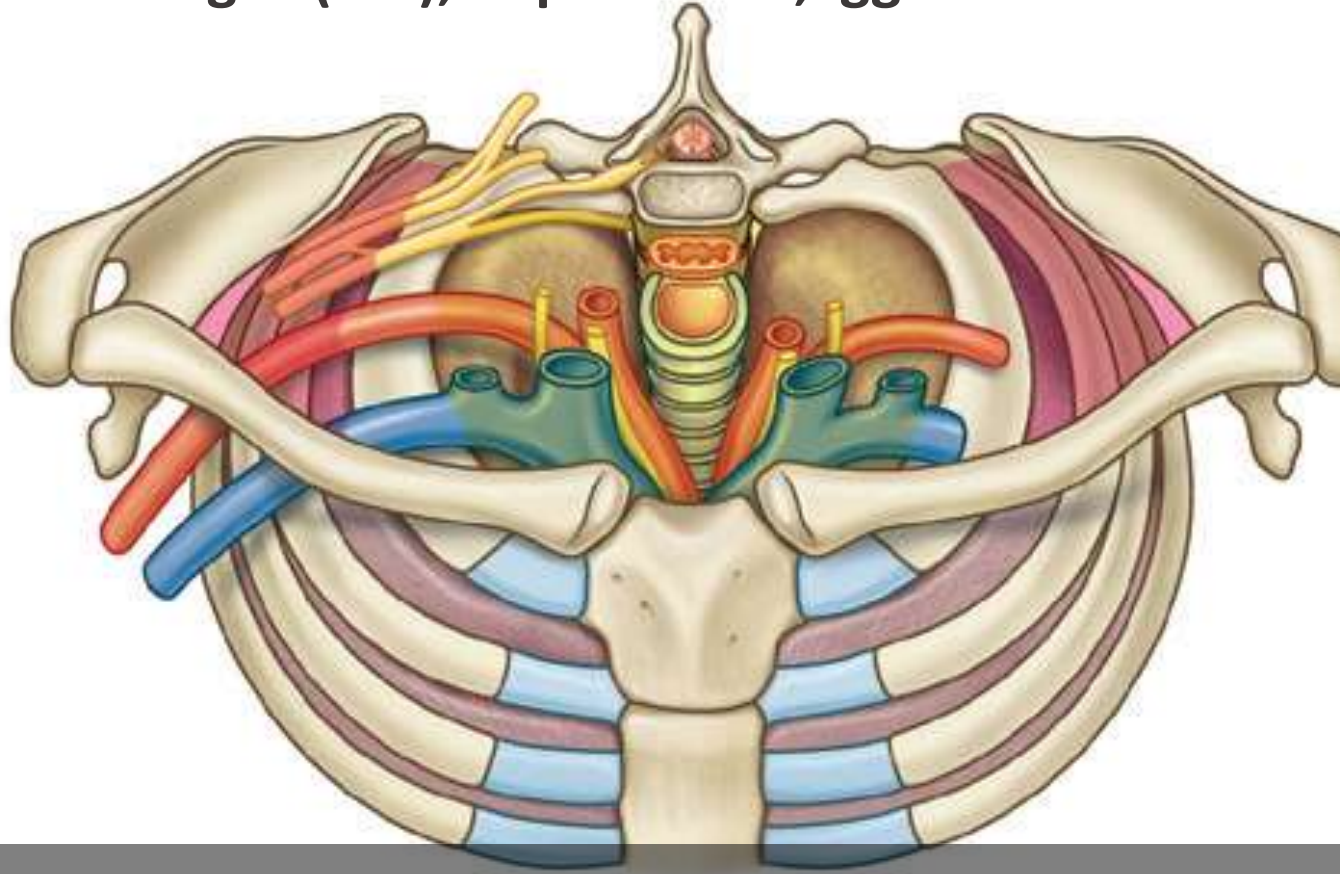
- ♦ **brathing**
- ♦ **Mechanical support to breathing**
 - ♦ Changes of the chest diameters
 - ♦ Craniocaudal changes
 - ♦ Chnges of preasures
 - ♦ Movings of diaphragm and ribs
- ♦ **Guarding of inner organs**
 - ♦ Lungs, heart, great vesels
 - ♦ Abdominal organs, liver, spleen, kidneys
- ♦ **continuation**
 - ♦ In axis – head – neck – abdomen - pelvis

CHEST FUNCTION

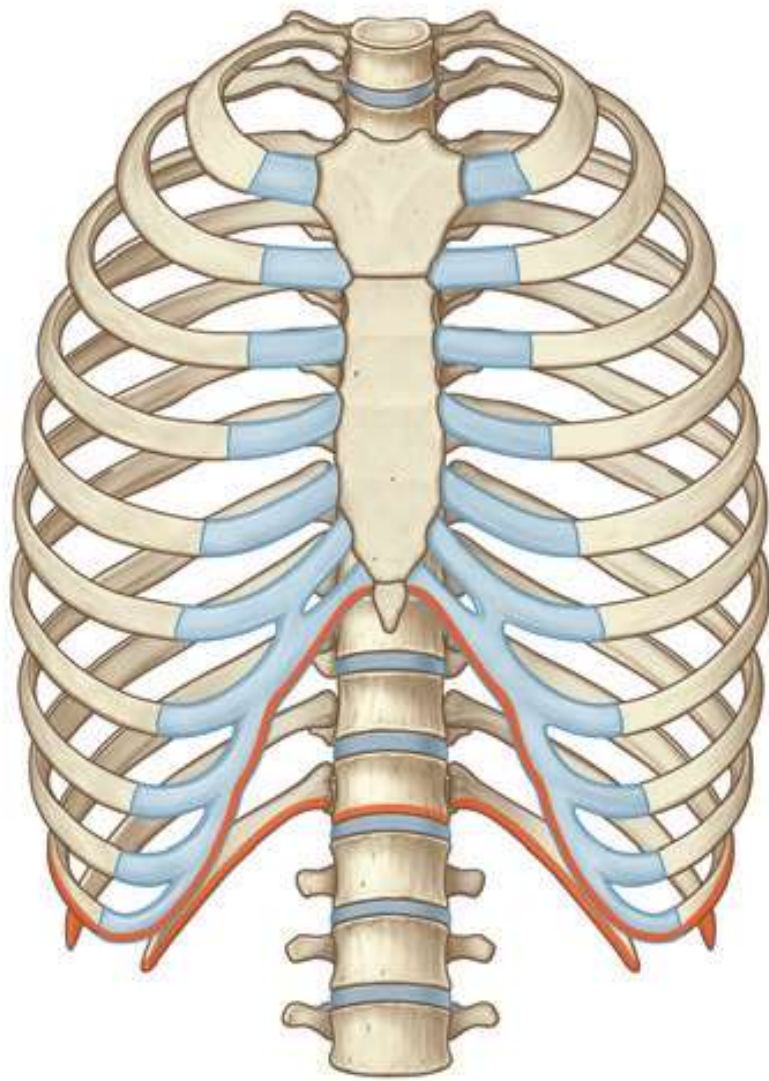


MECHANICS OF BREATHING

- ♦ **Vertebr Th1, 1. rib, manubrium sterni (level of disc Th2/3)**
- ♦ **a. carotis communis, a. subclavia**
- ♦ **v. jugularis interna, v. jugularis externa, v. subclavia**
- ♦ **n. vagus (n.X), n. phrenicus, ggl. cervicale inferius, truncus sympathicus, plexus brachialis**



APERTURA THORACICA SUPERIOR



♦ diaphragm

♦ *Dorsal insertion*

♦ *Th12*

♦ *Lateral insertion*

♦ *costa XII, costa XI (apex)*

♦ *Ventral isertion*

♦ *costa X, synchondrosis of c. VII-X*

♦ **Copula dextra, copula sinistra**

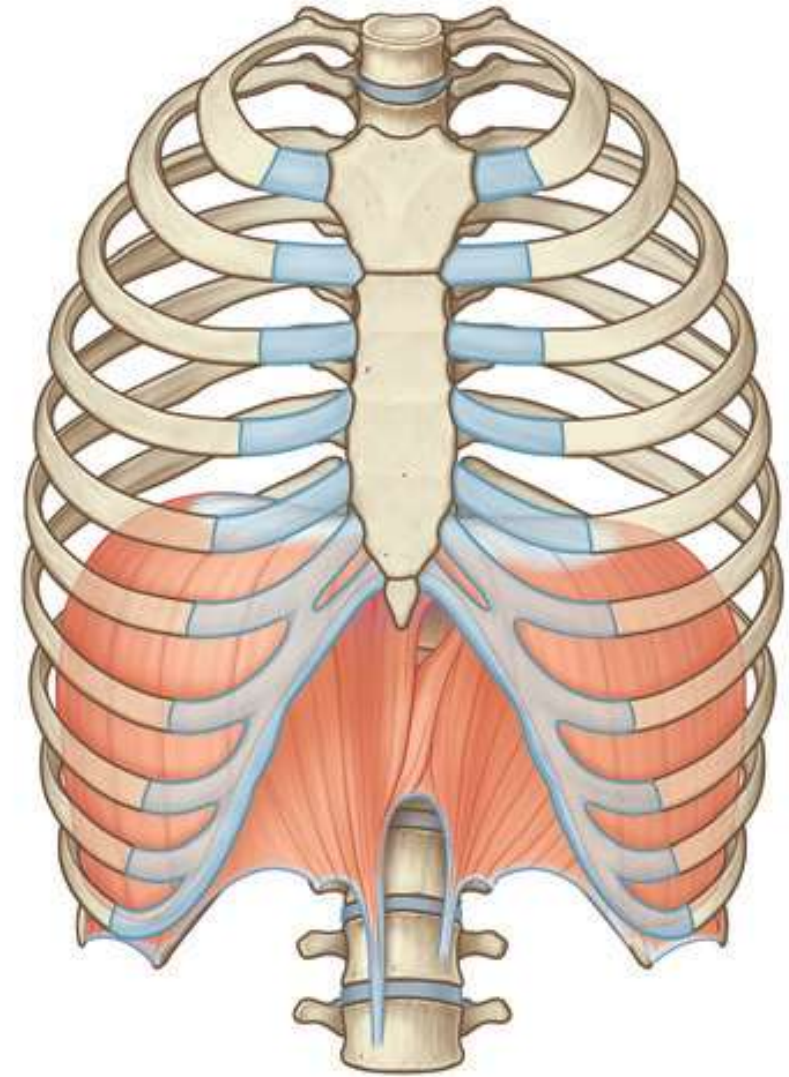
♦ **Crus diaphragmatis**

♦ **Hiathus diaphramaticus**

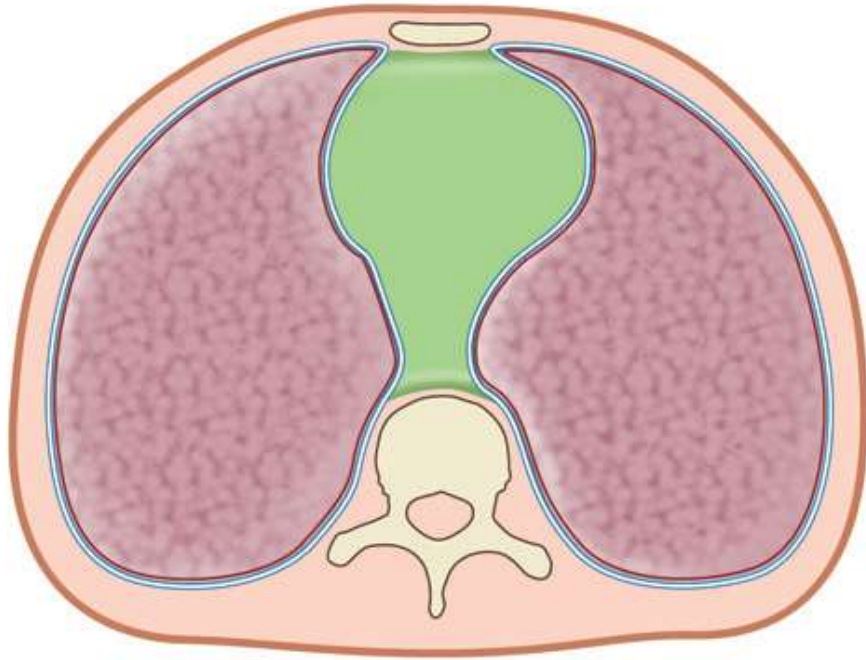
♦ **aorticus**

♦ **oesophagealis**

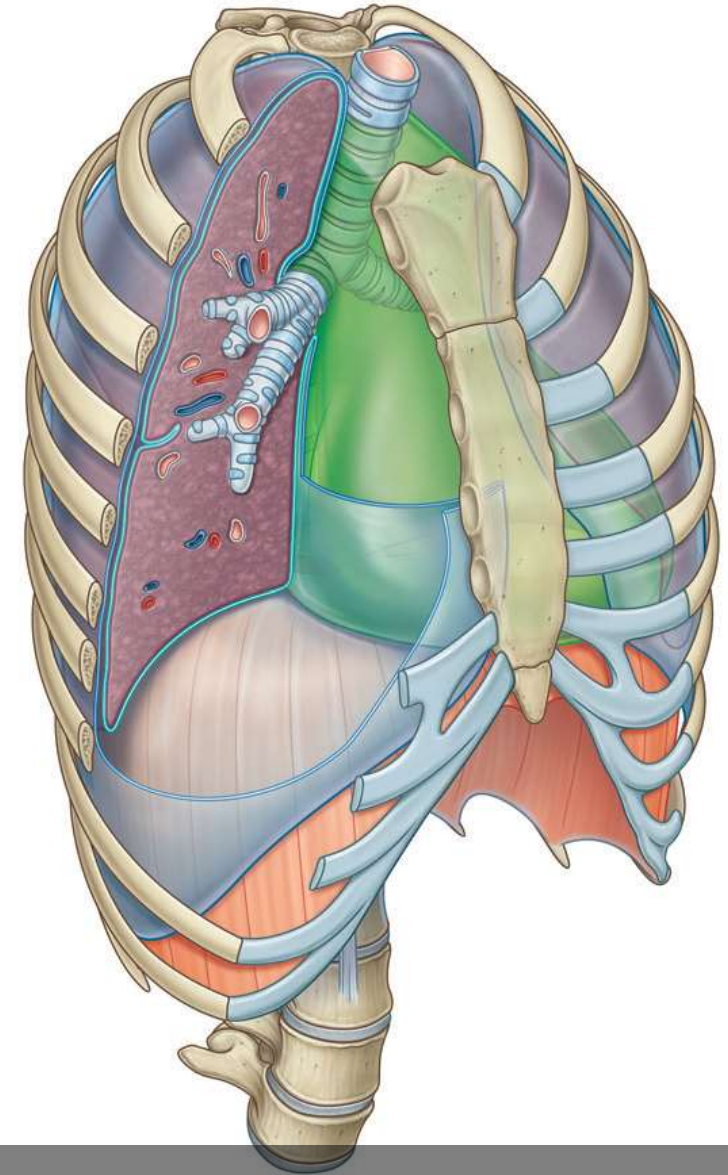
♦ **vena cavae**



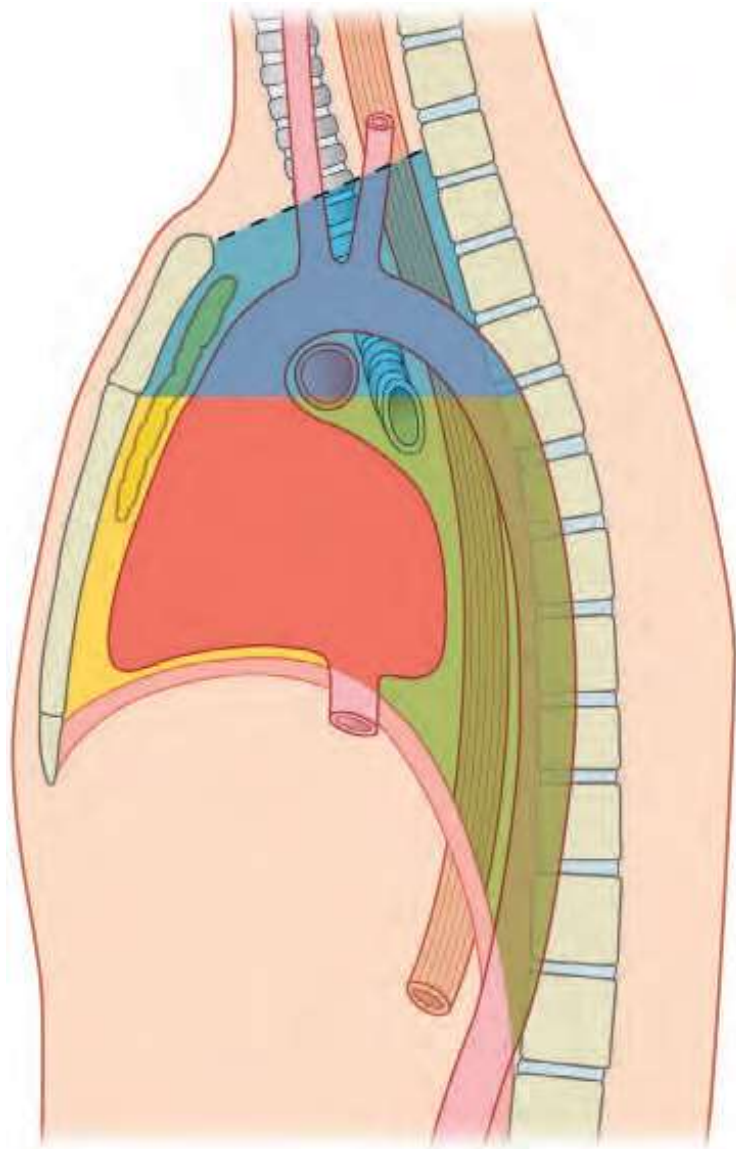
APERTURA THORACICA INFERIOR



- ♦ **Three compartements**
- ♦ **Mediastinum**
 - ♦ **Sagital orientation**
 - ♦ *Heart, great vessels, trachea*
 - ♦ *oesophageus*
- ♦ **Pleural cavity left**
 - ♦ *Surrounding left lung*
- ♦ **Pleural cavity right**
 - ♦ *Surrounding right lung*
- ♦ **Chest wall**
 - ♦ *The own wall*
 - ♦ *Breast*



CHEST COMPARTMENTS



♦ Mediastinum superius

- ♦ Aorta ascendens Arcus aortae
- ♦ Venae brachiocephalicae
- ♦ Trachea
- ♦ Oesophagus

♦ Mediastinum anterius

- ♦ Thymus
- ♦ A. et v. thoracica interna

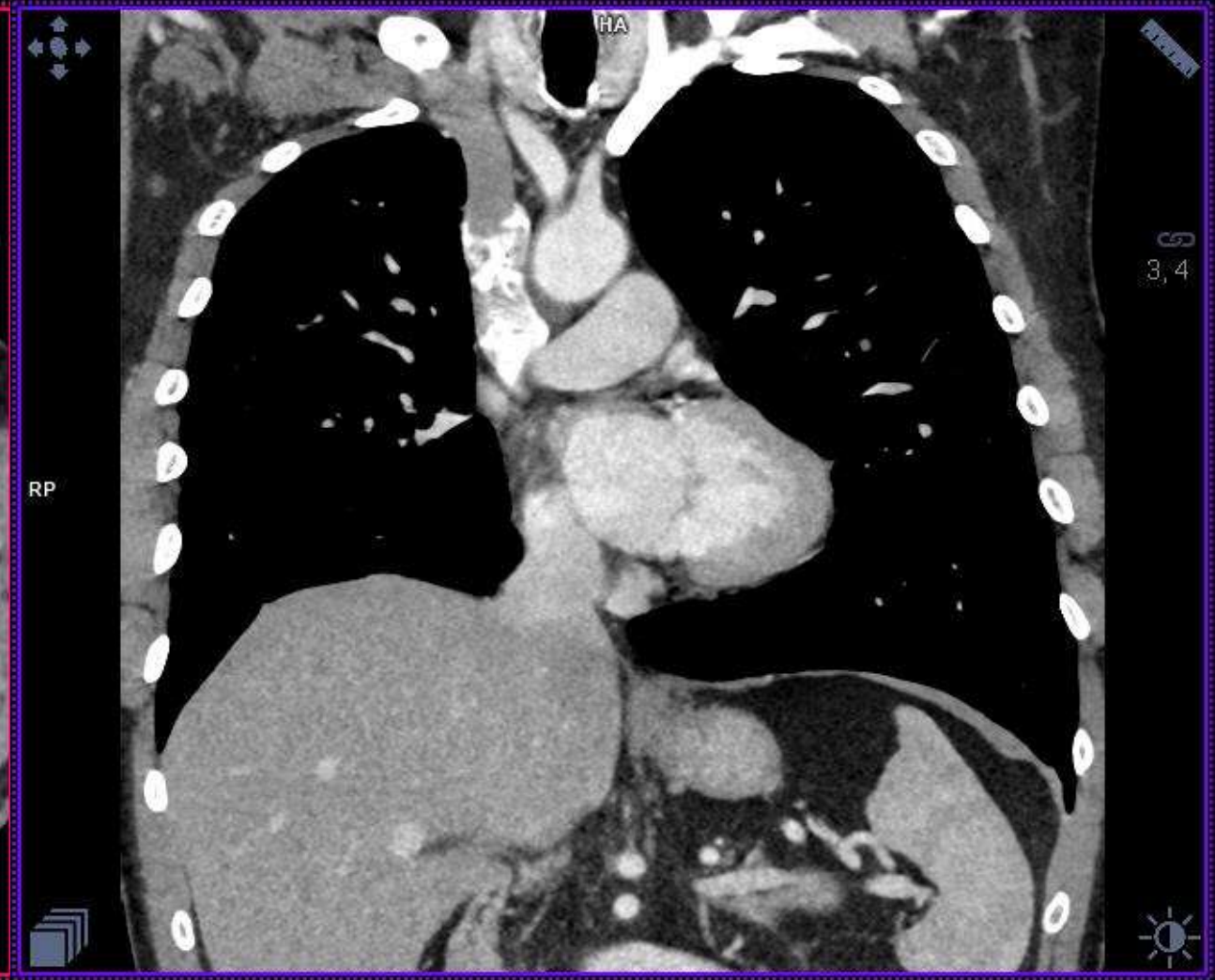
♦ Mediastinum medius

- ♦ cor

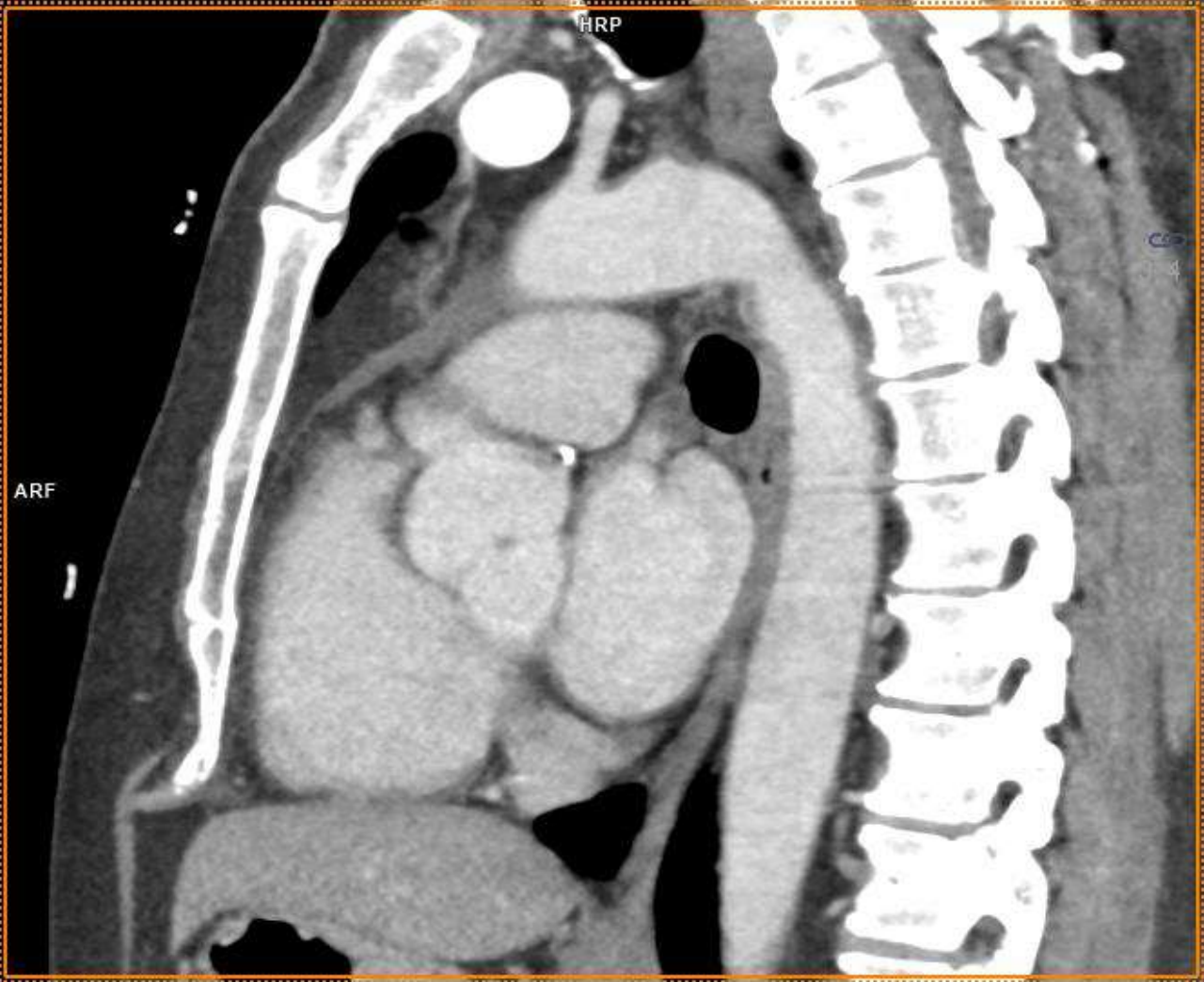
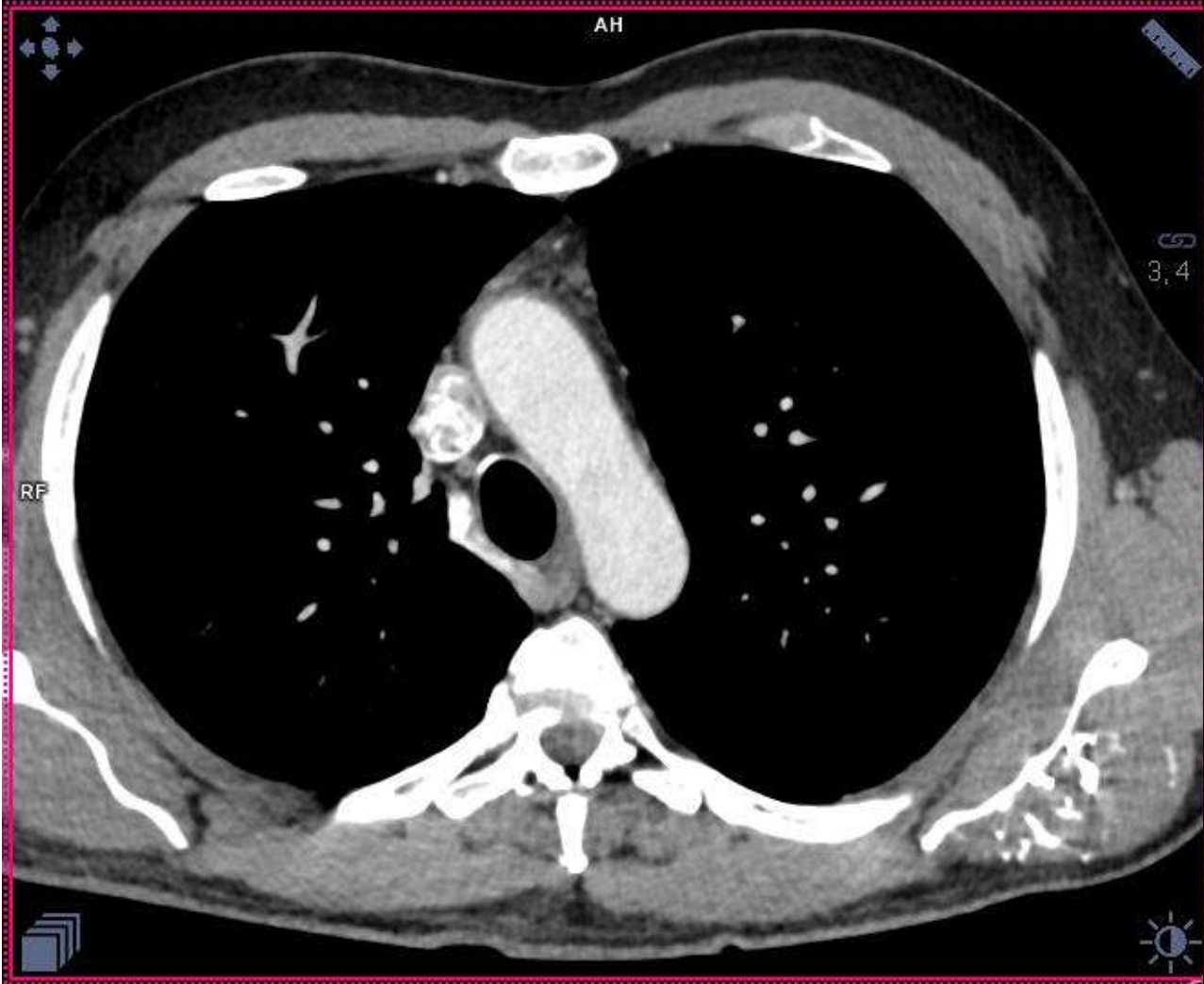
♦ Mediastinum posterius

- ♦ Oesophagus
- ♦ Bronchi
- ♦ Aorta descendens
- ♦ Vena azygos et hemiazygos
- ♦ Ductus thoracicus

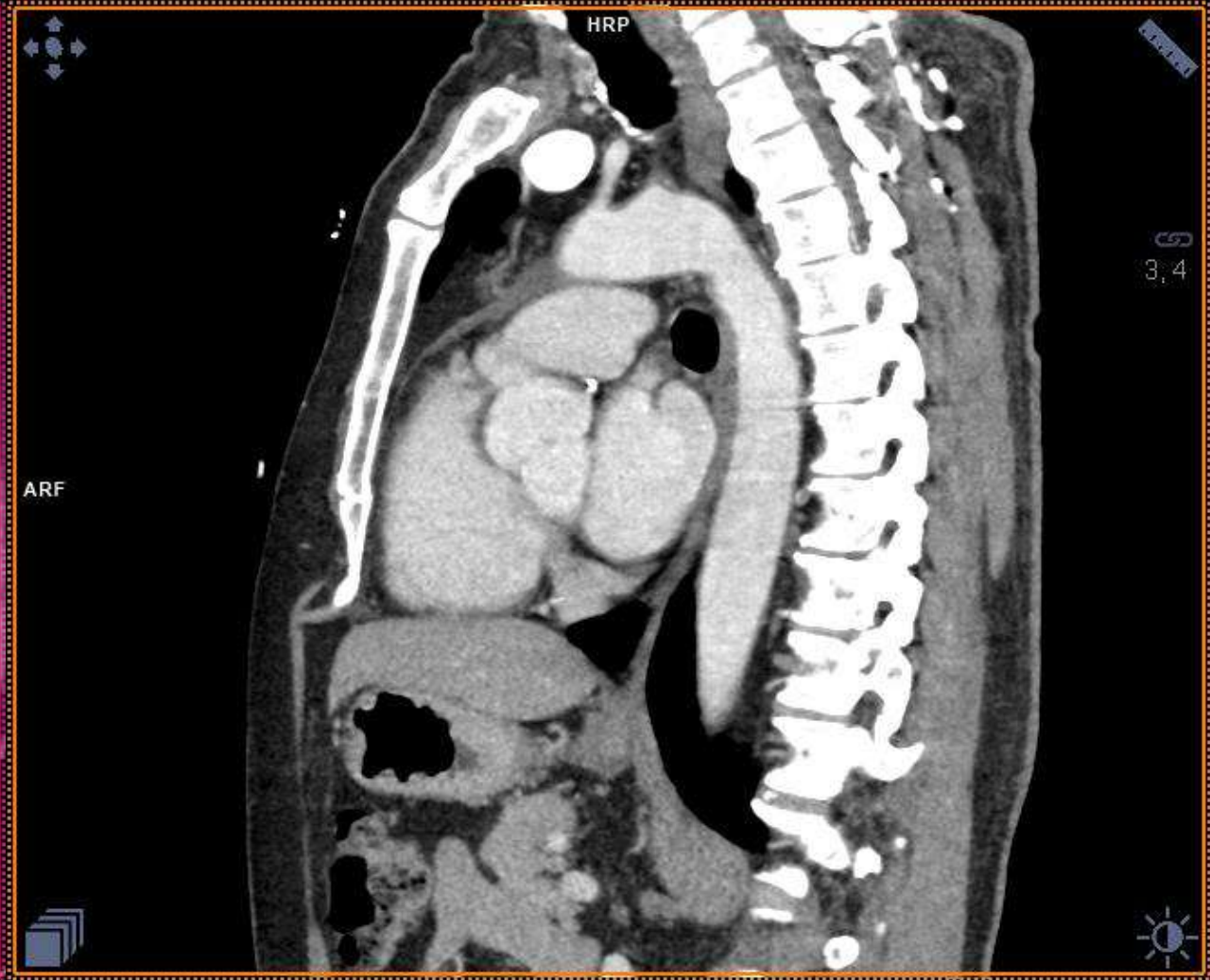
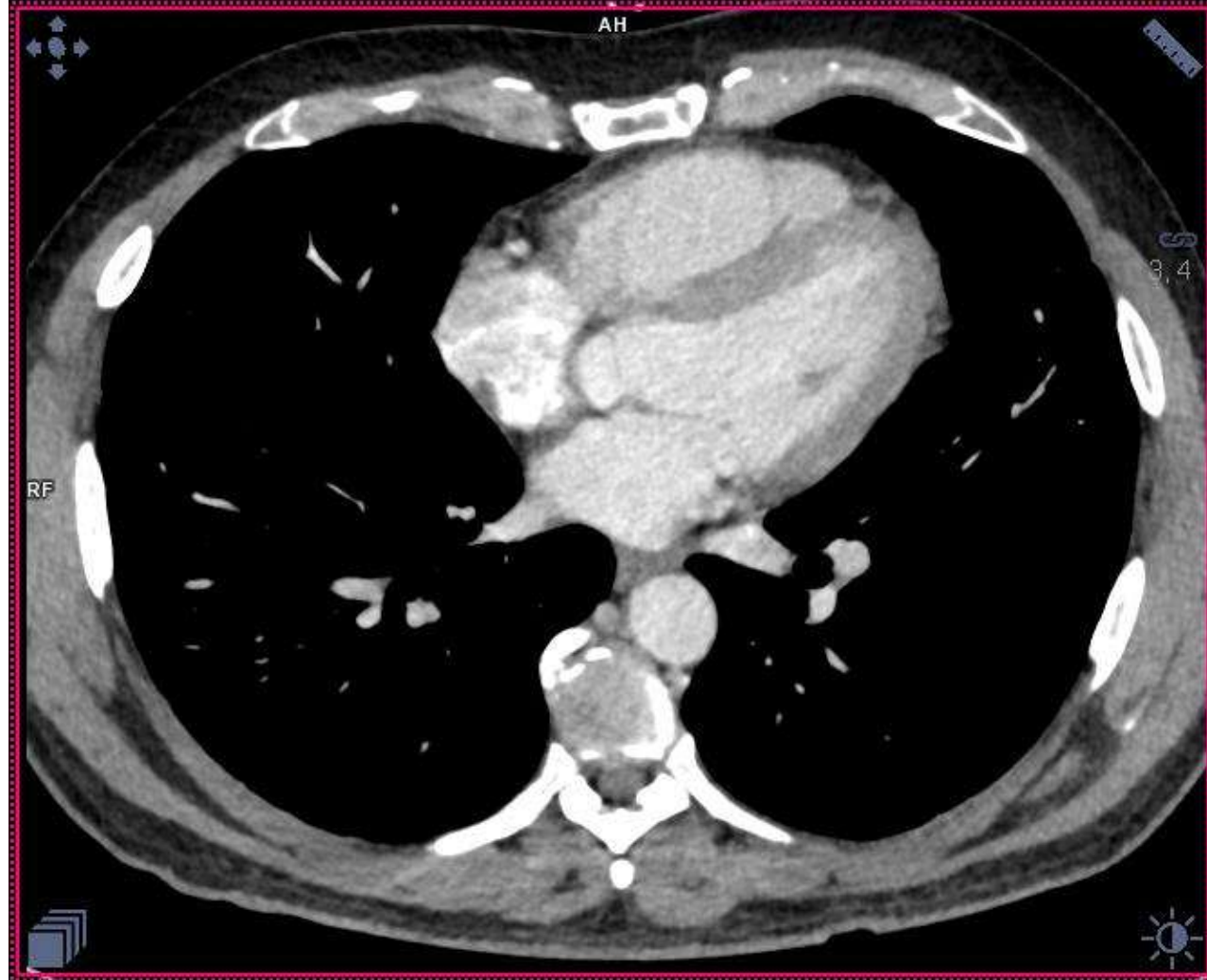
MEDIASTINUM



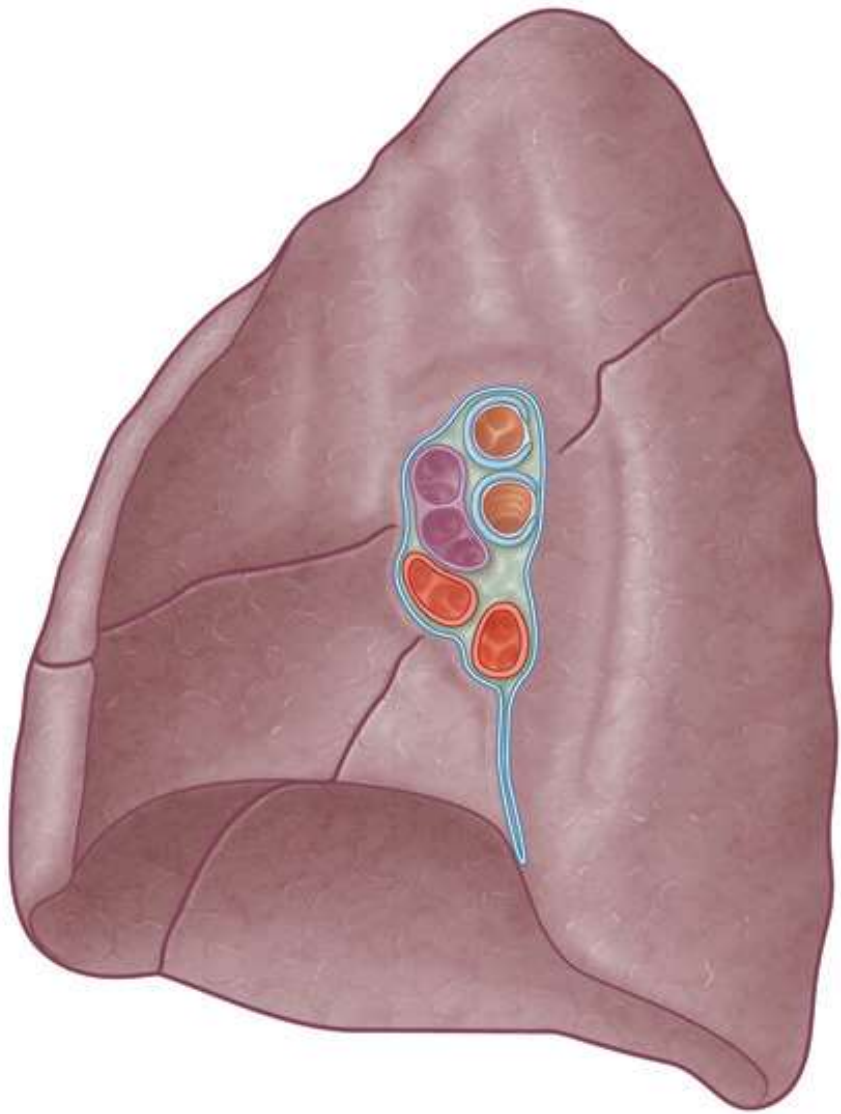
MEDIASTINUM



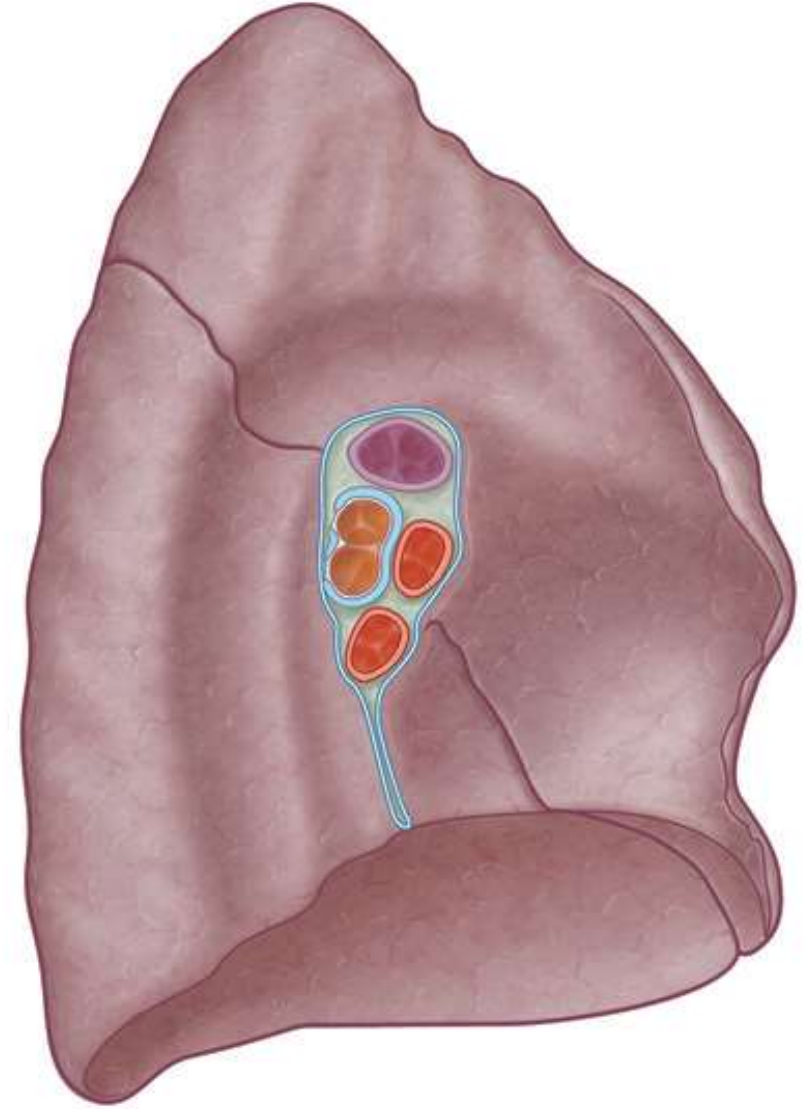
MEDIASTINUM



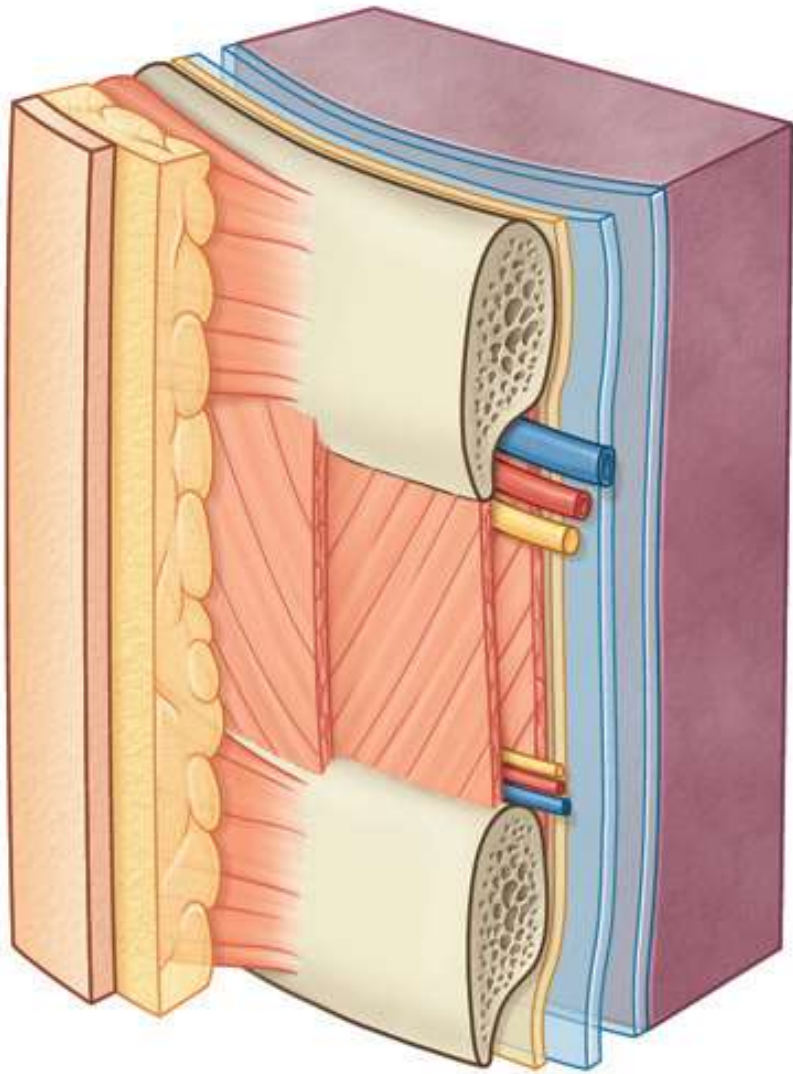
MEDIASTINUM



- HILUM
- Bronchus
- A. pulmonalis
- V. pulmonalis
- A. bronchialis
- Lig. pulmonale

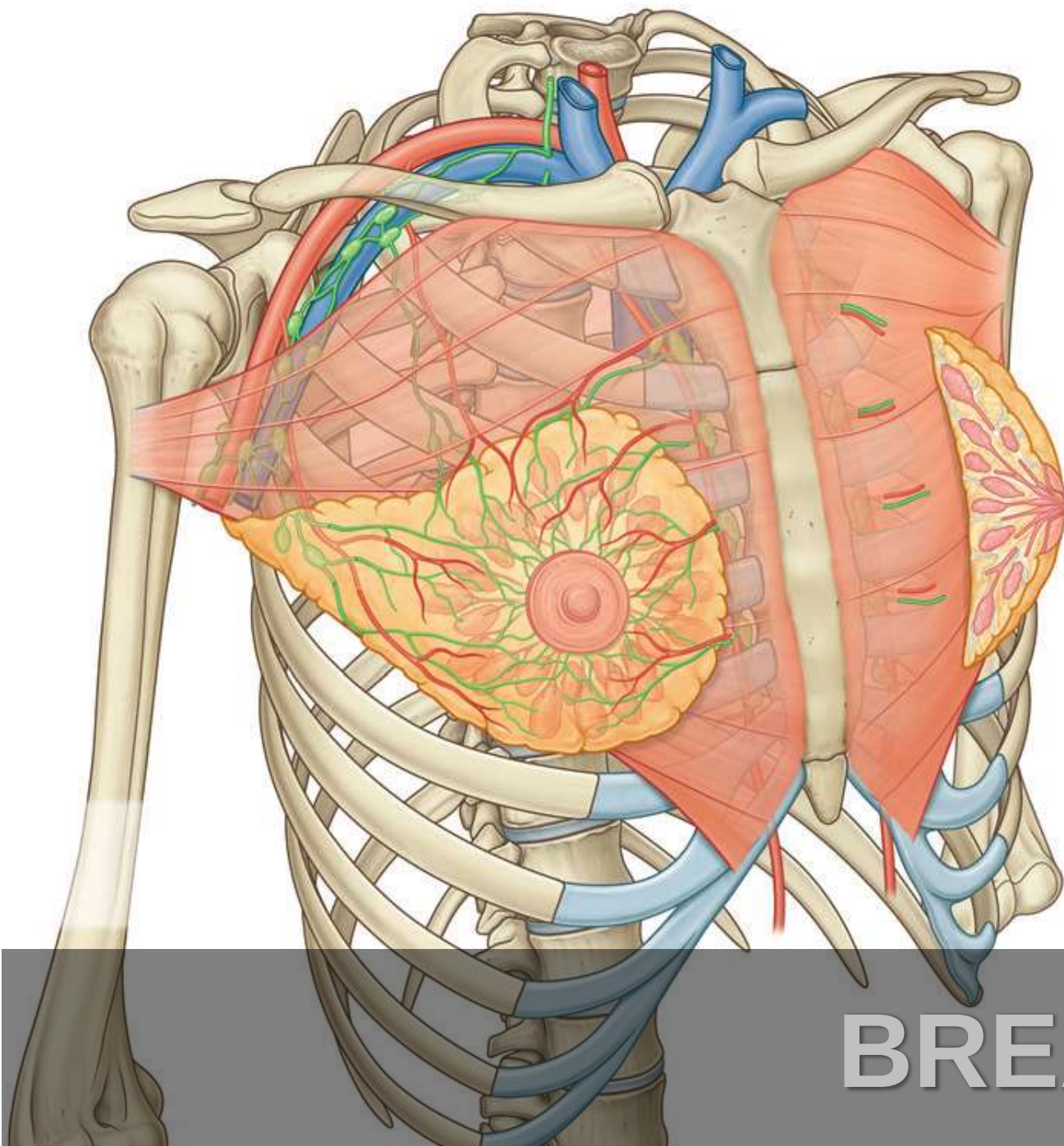


CONNECTION MEDIASTINUM - LUNG



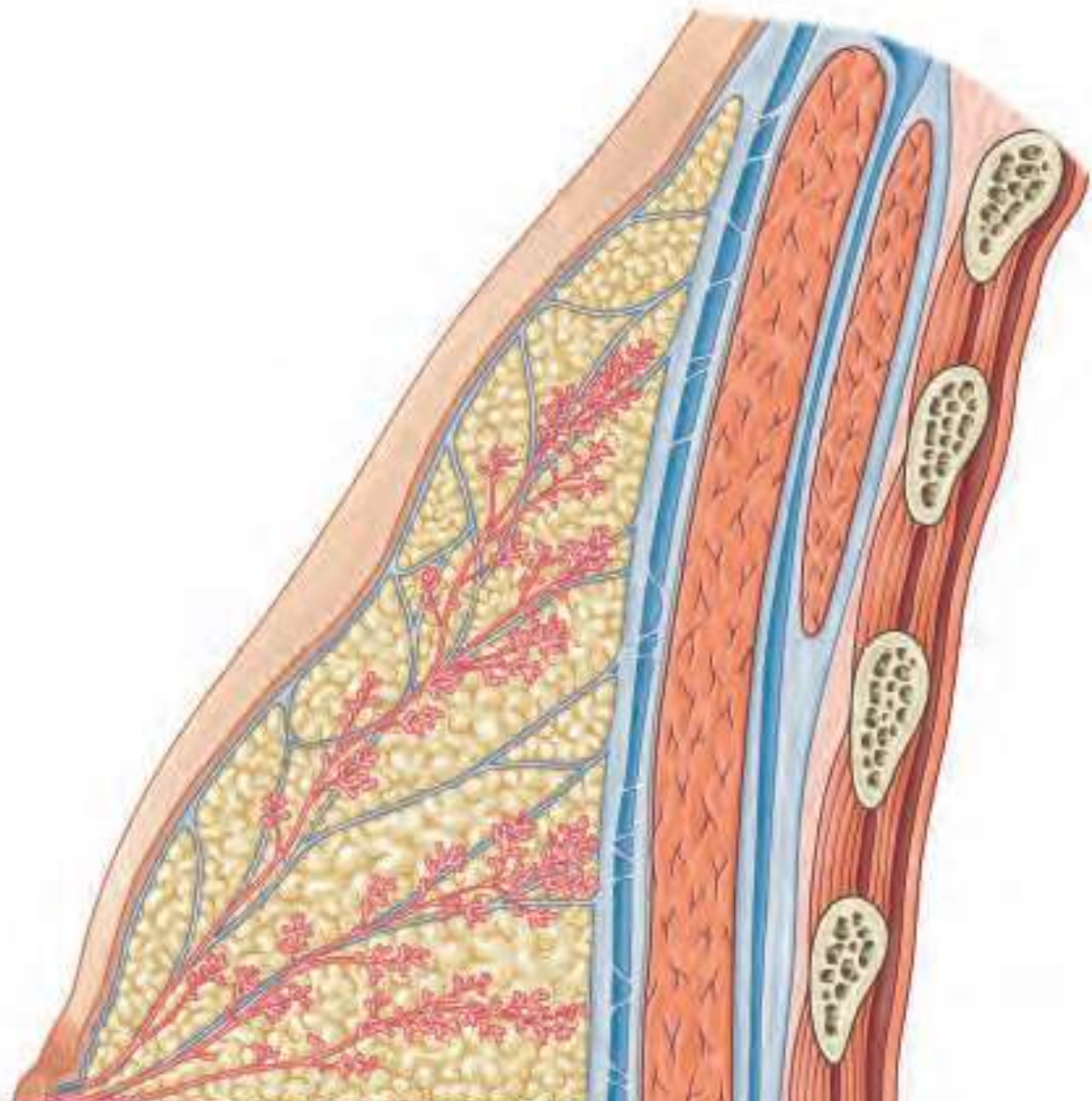
- skin
- Subcutaneous tissue
- Muscles – connected to upper extremity
- Bones
- Intercostal muscles
- Fascia endothoracica
- Pleura parietalis
- Pleura visceralis
- Parenchyma pulmonis
- Breast – glandula lactifera

CHEST WALL



- ♦ **M. pectoralis major**
- ♦ **Upper margin - 2. - 3. rib**
 - ♦ Axillary process
- ♦ **Lower margin 5-6. rib**
- ♦ **Deep fascia**
- ♦ **Submamary space**
- ♦ **Gland**
 - ♦ the own glandular tissue
 - ♦ ductus lactiferi
- ♦ **Papilla**
 - ♦ 20-23 cm far from jugulum and each other
- ♦ **Areola**

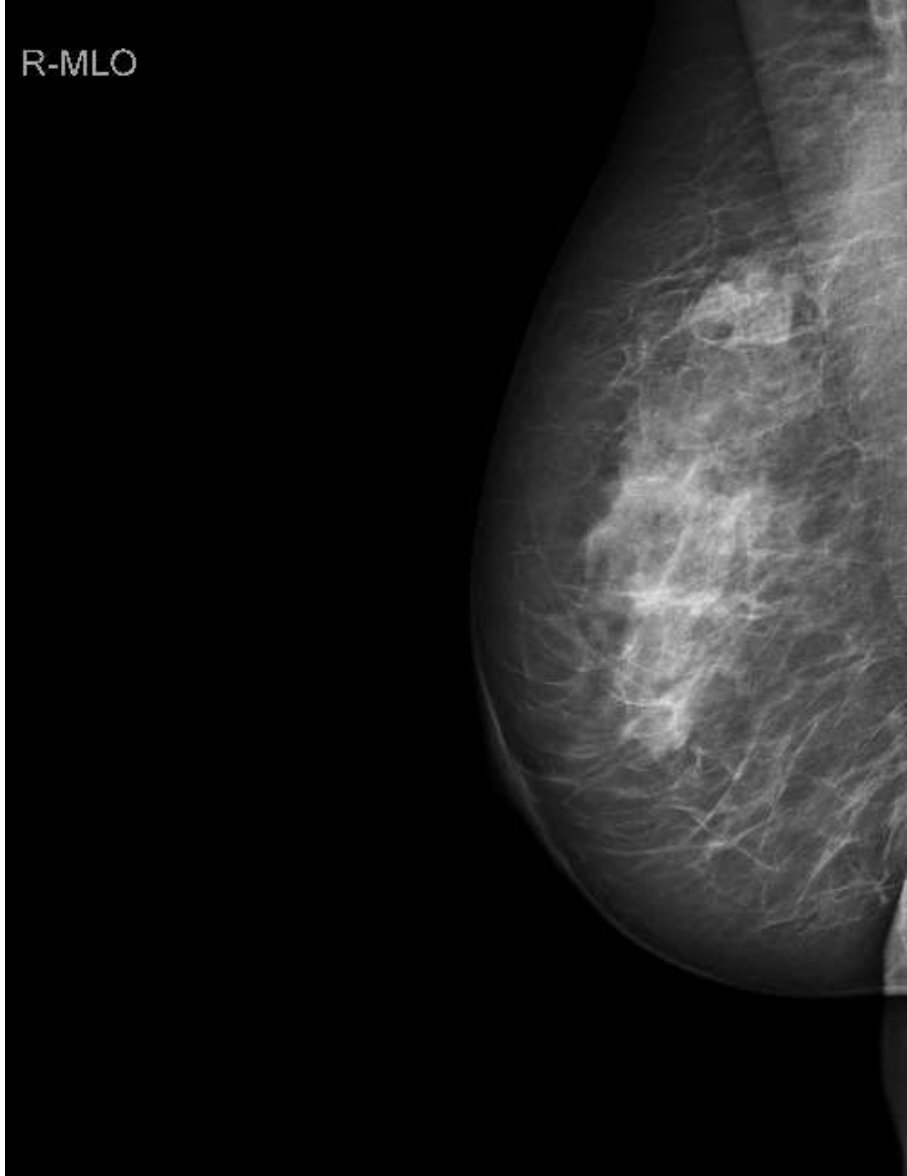
BREAST



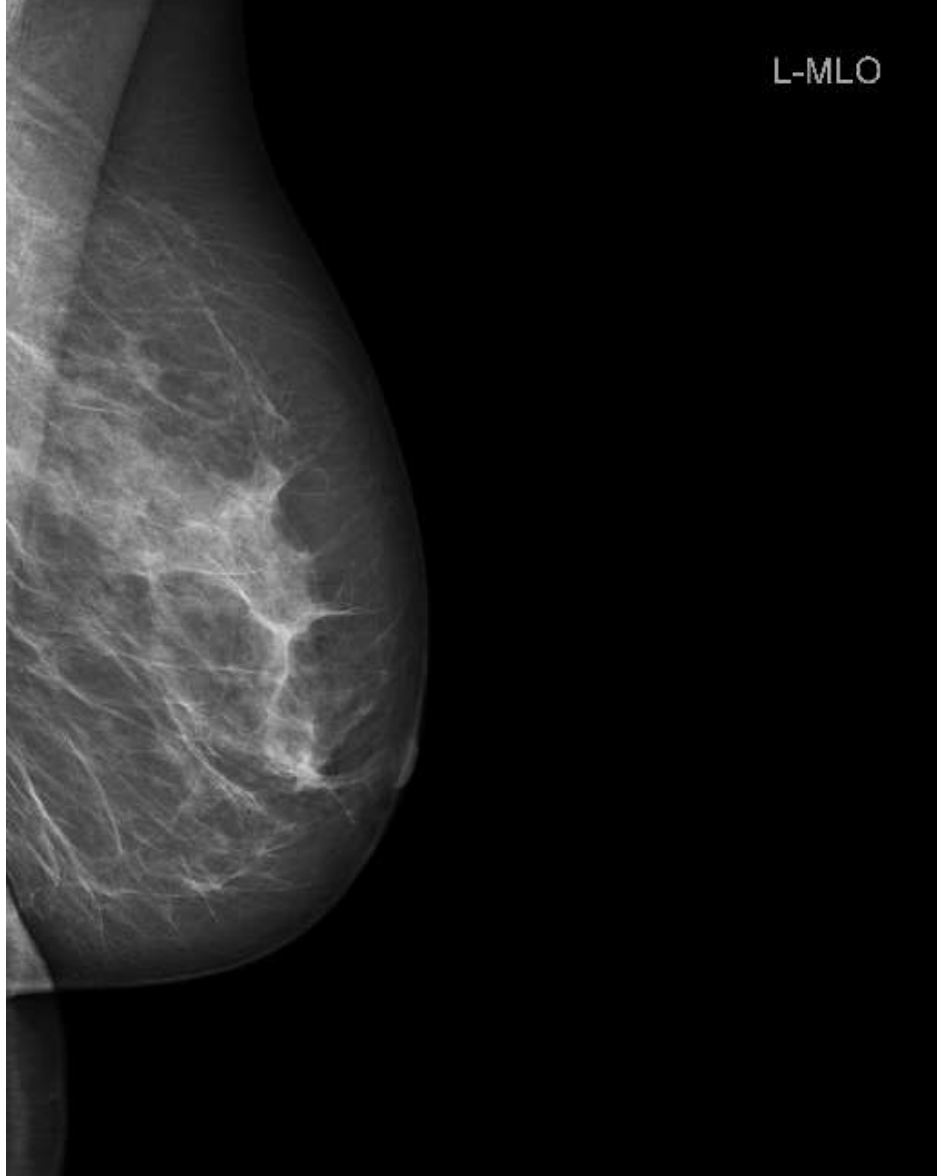
- ◆ Chest wall(costae, mm. intercostales)
- ◆ M. pectoralis minor
- ◆ M. pectoralis major
- ◆ Fascia pectoralis
- ◆ Spatium submamare
- ◆ Fascia profunda
- ◆ Tela adiposa
- ◆ Tela glandularia
- ◆ Ligamenta suspensoria Cooperi
- ◆ Fascia superficialis
- ◆ Skin

BREAST

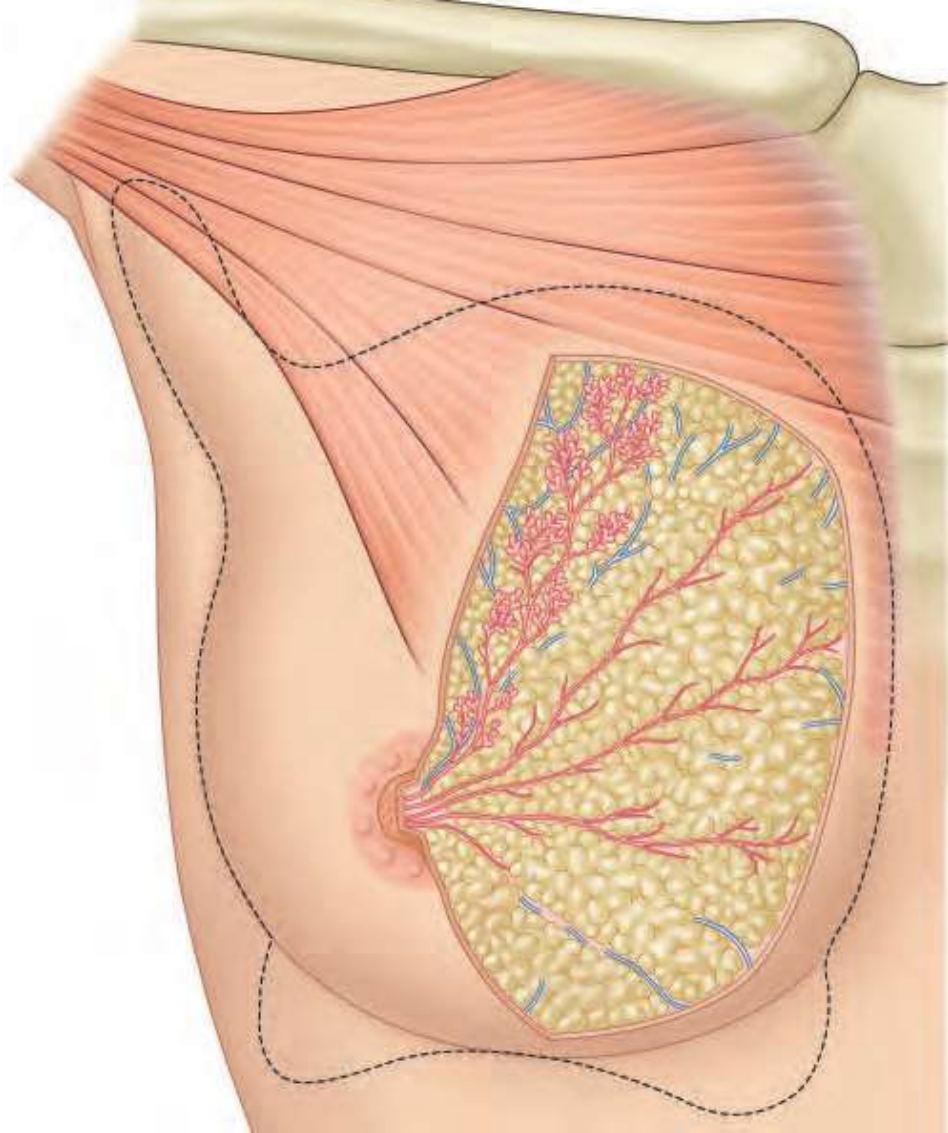
R-MLO



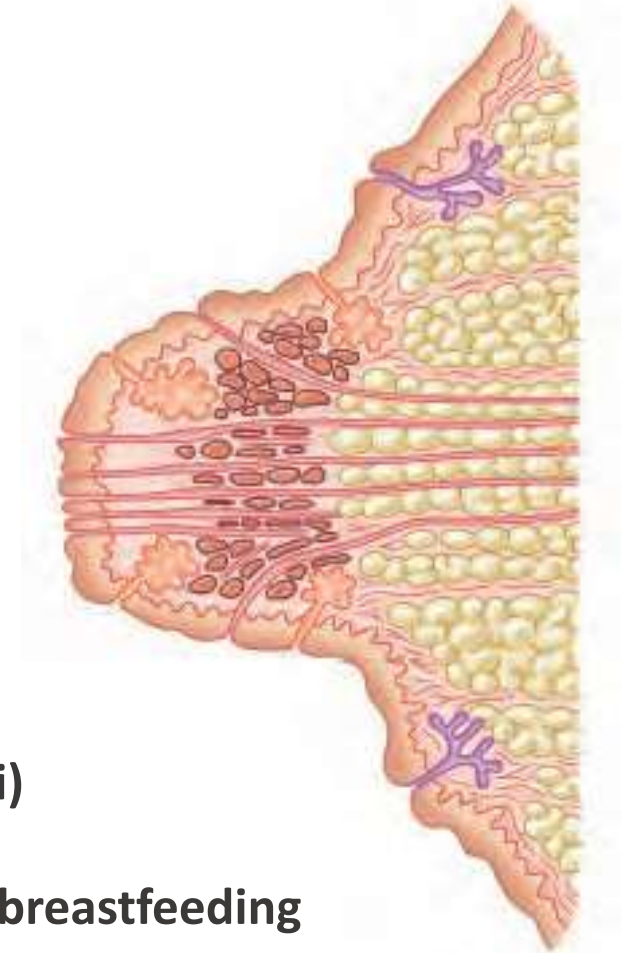
L-MLO



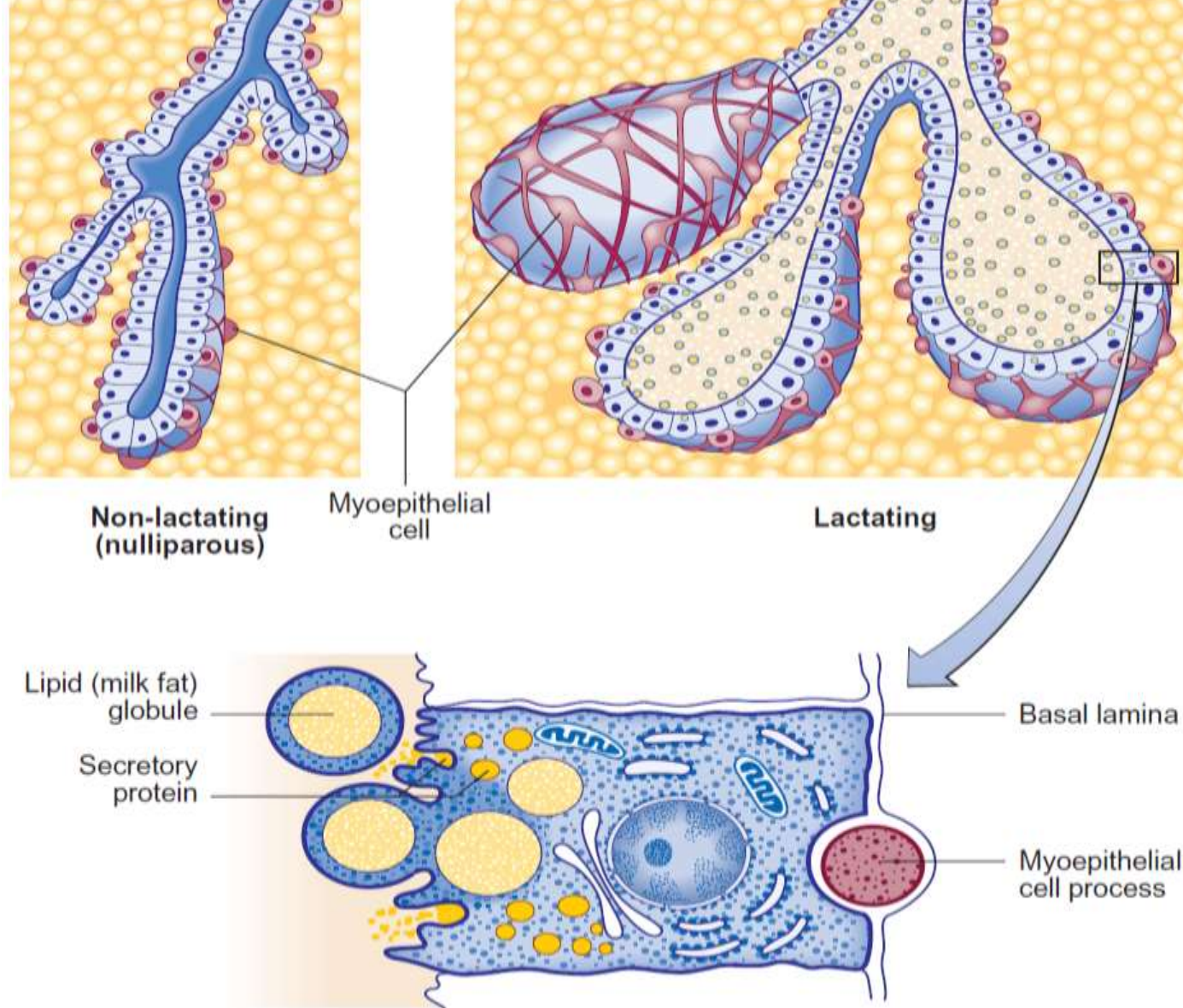
BREAST CARCINOMA



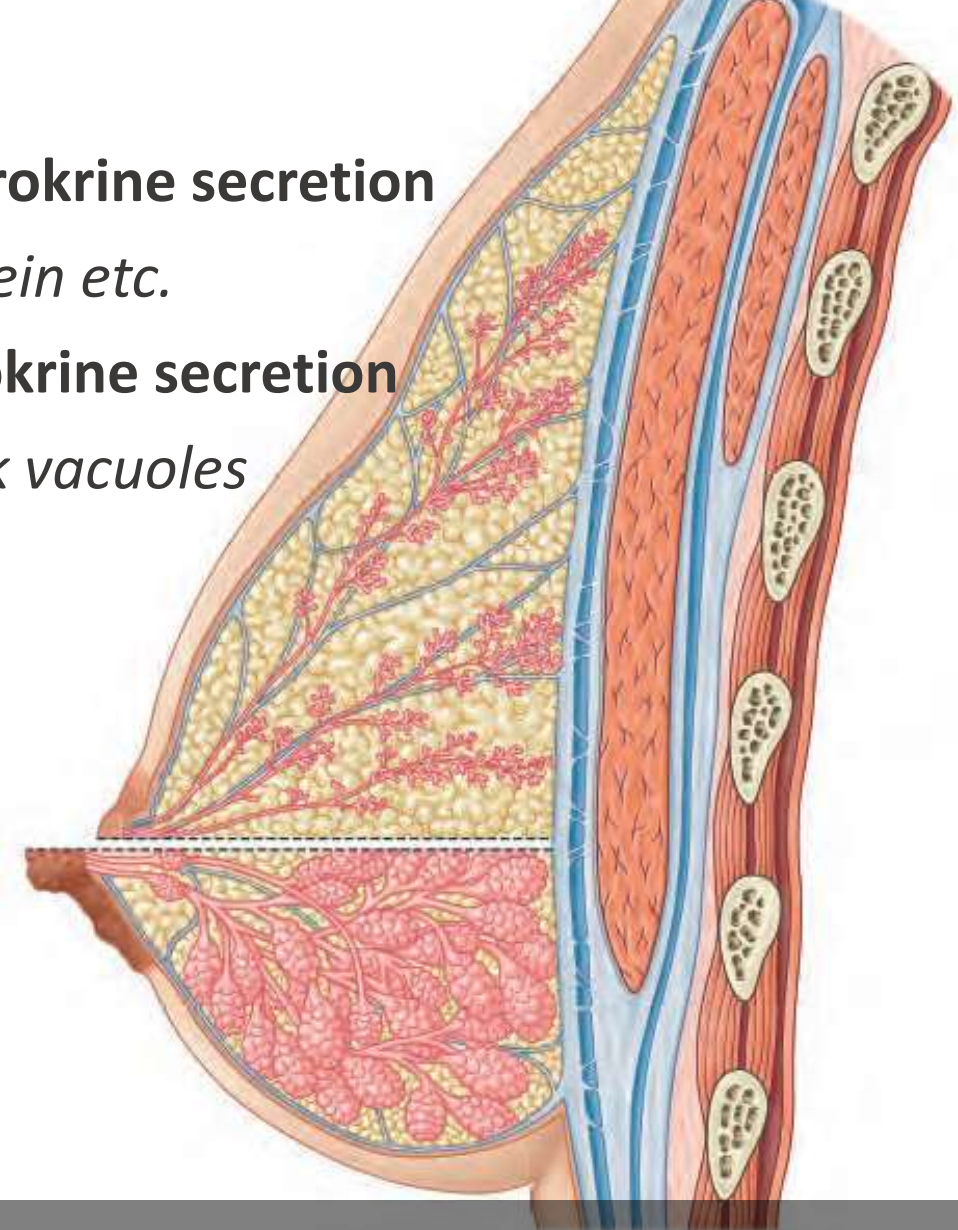
- ♦ **Alveolus**
- ♦ **Lobulus**
- ♦ **Ductus lactiferus (10-15)**
 - ♦ Sinus lactiferus
- ♦ **nipple**
 - ♦ Openings of ducts
- ♦ **Areola**
 - ♦ pigmented
 - ♦ Gll. saebaceae
 - ♦ Gll. areolares (Montgomeri)
 - ♦ Tubercula Montgomeri)
 - ♦ Oily secret – lubrication in breastfeeding



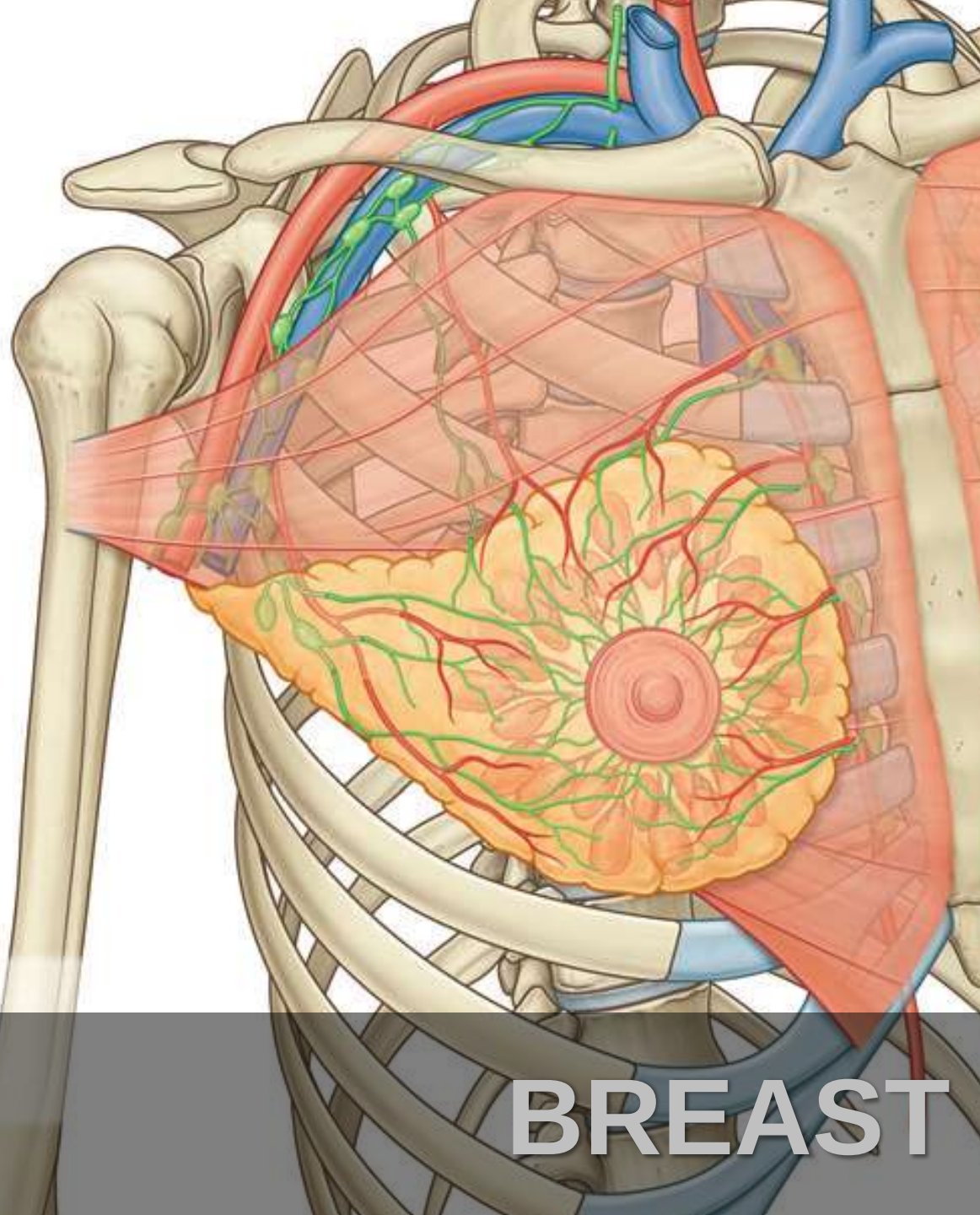
MAMMA



- ♦ **Merocrine secretion**
- ♦ *Casein etc.*
- ♦ **Apocrine secretion**
- ♦ *Milk vacuoles*

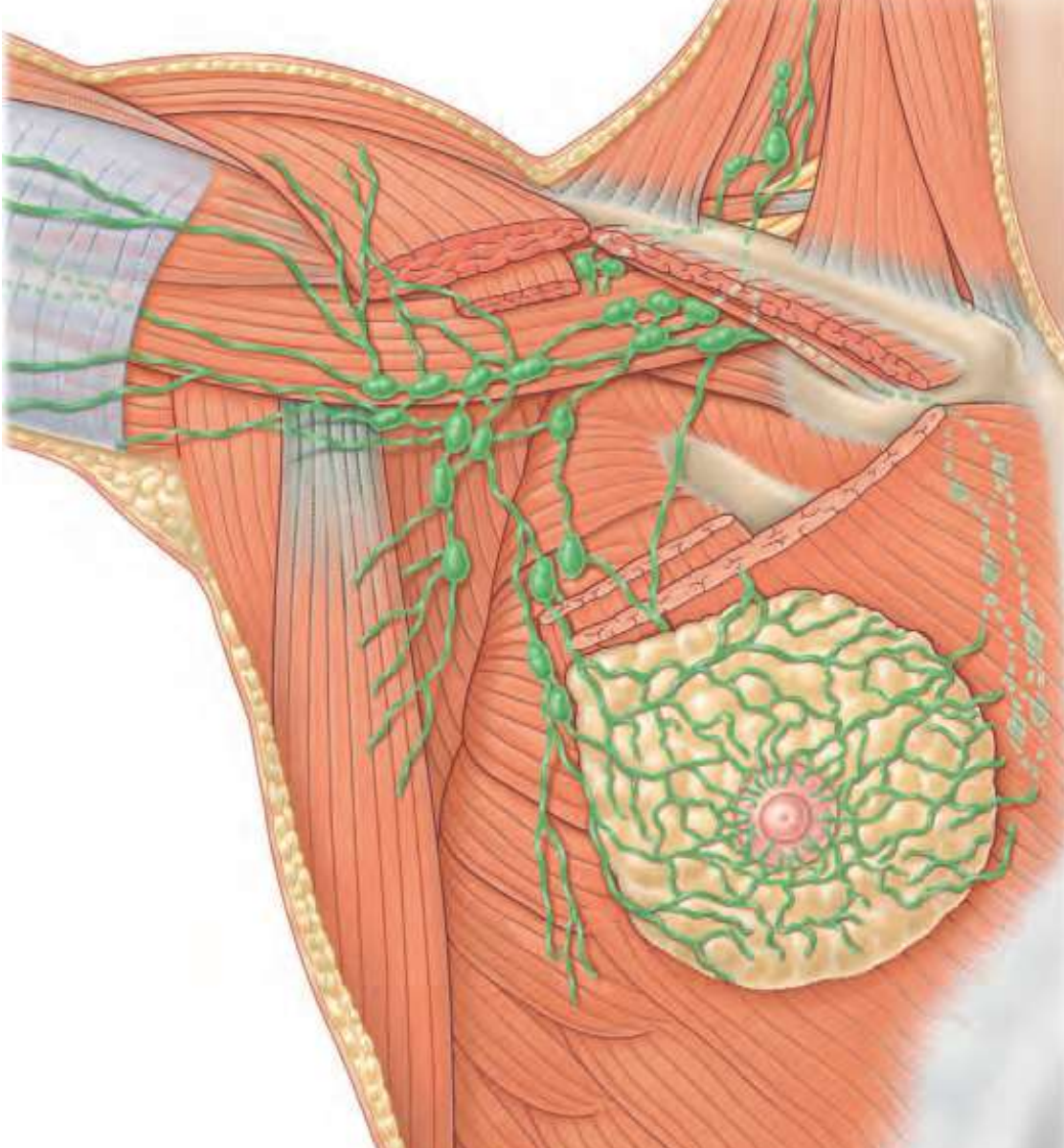


LACTATION



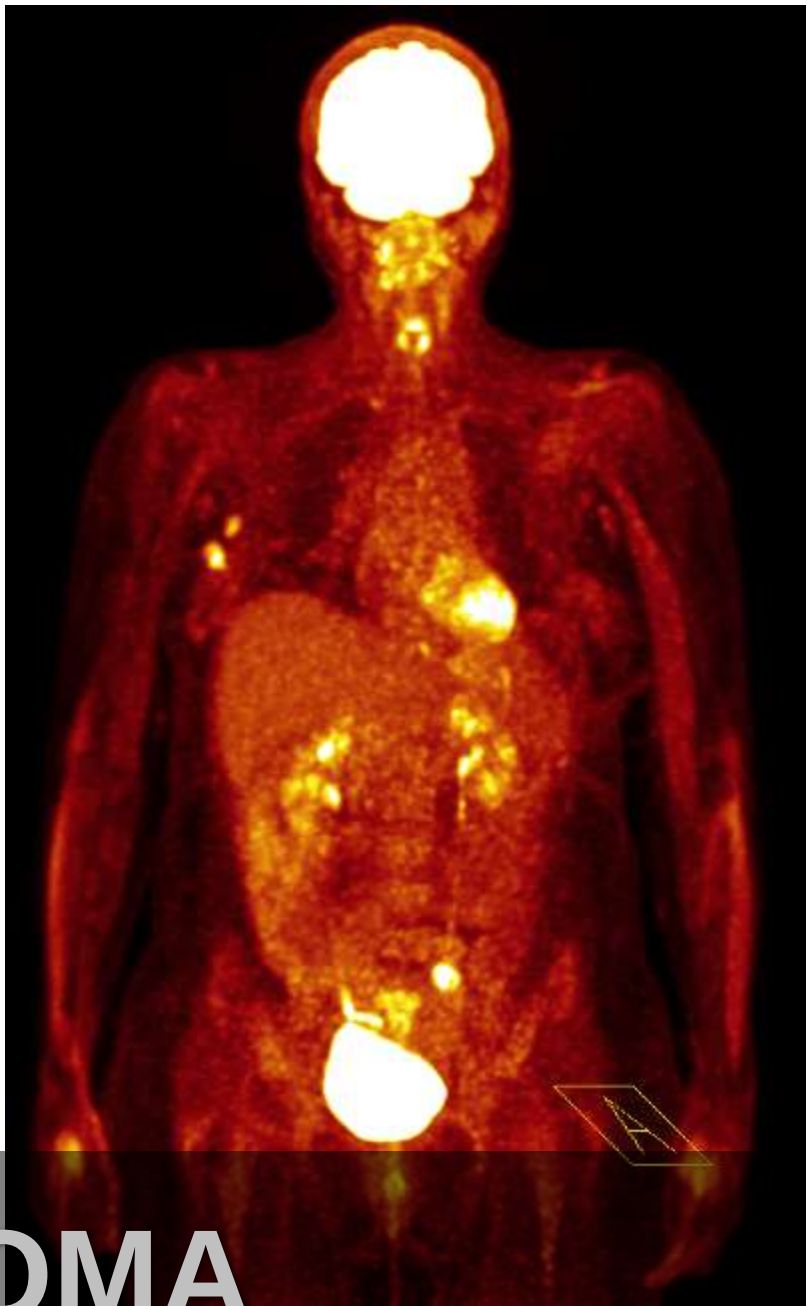
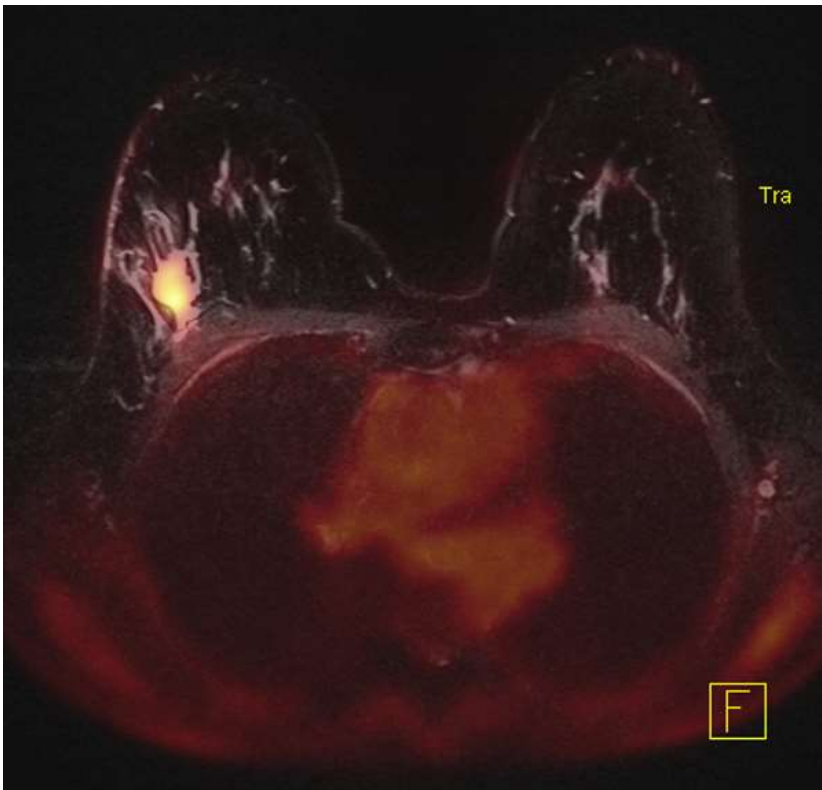
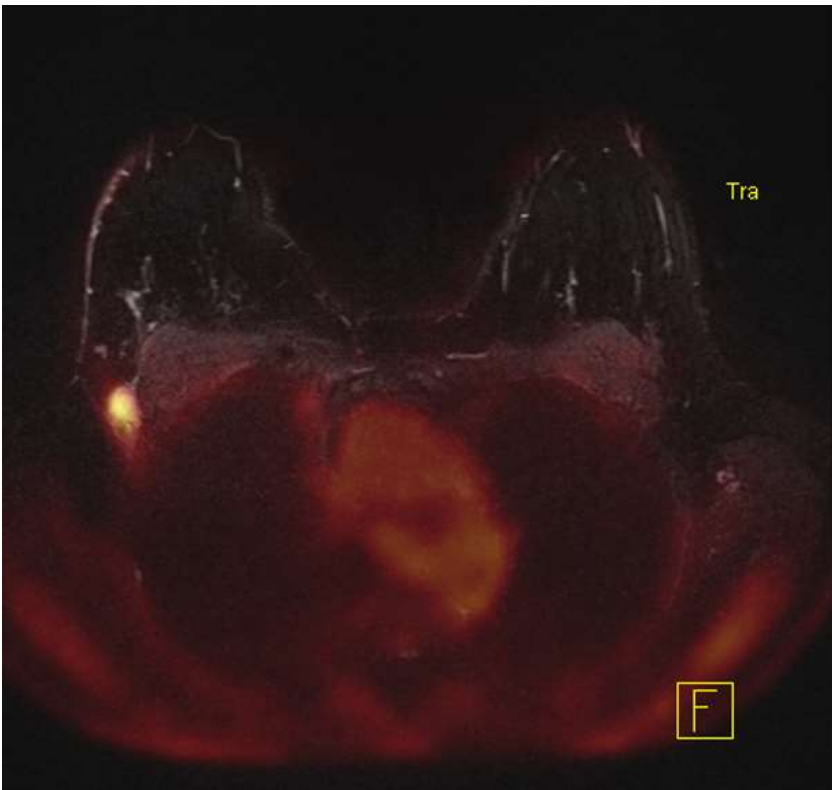
- ♦ a. thoracica lateralis
- ♦ A. thoracoacromialis
- ♦ A. thoracica interna
 - ♦ Rami mammarii

BREAST VESSELS

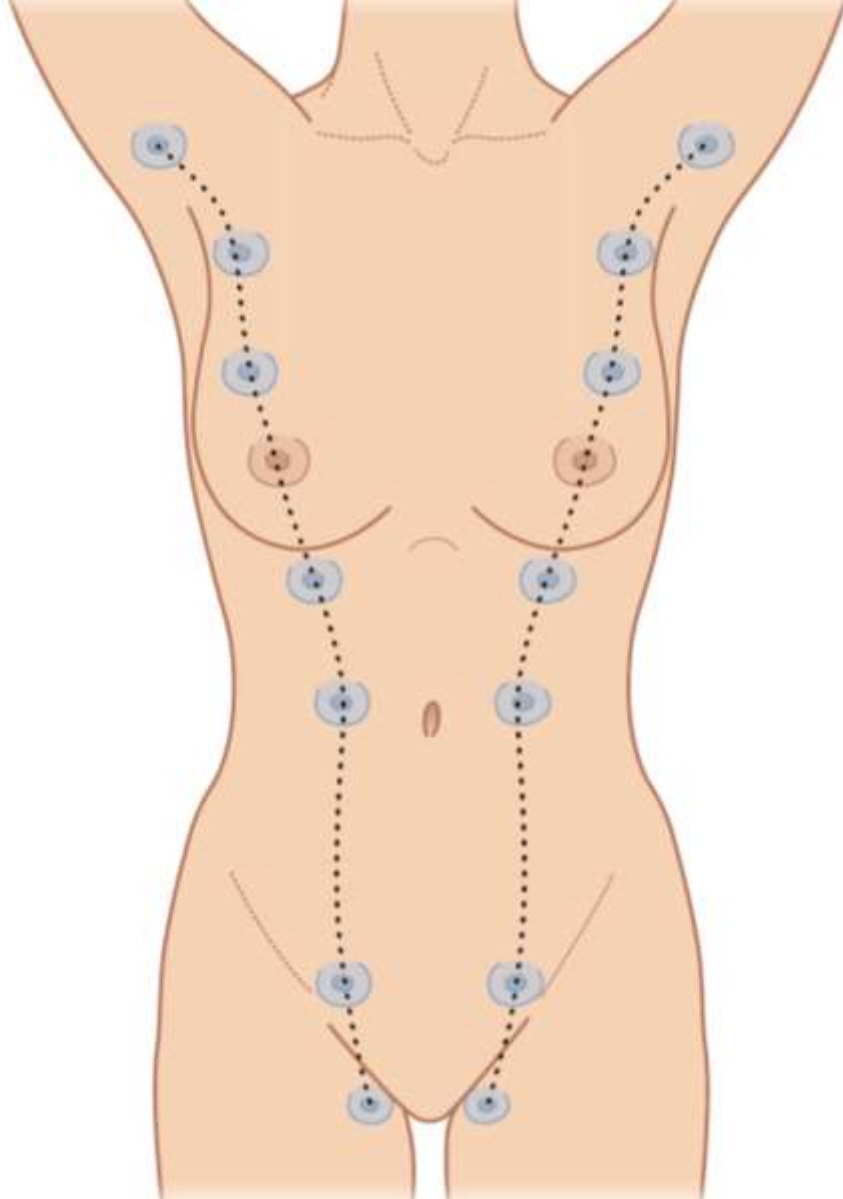


- ♦ Intramammary nodes
- ♦ Axillary nodes
- ♦ I., II., and III. stages
- ♦ Supraclavicular nodes
- ♦ intrathoracic
- ♦ vasa thoracica interna

BREAST LYMPHATICS



BREAST CARCINOMA

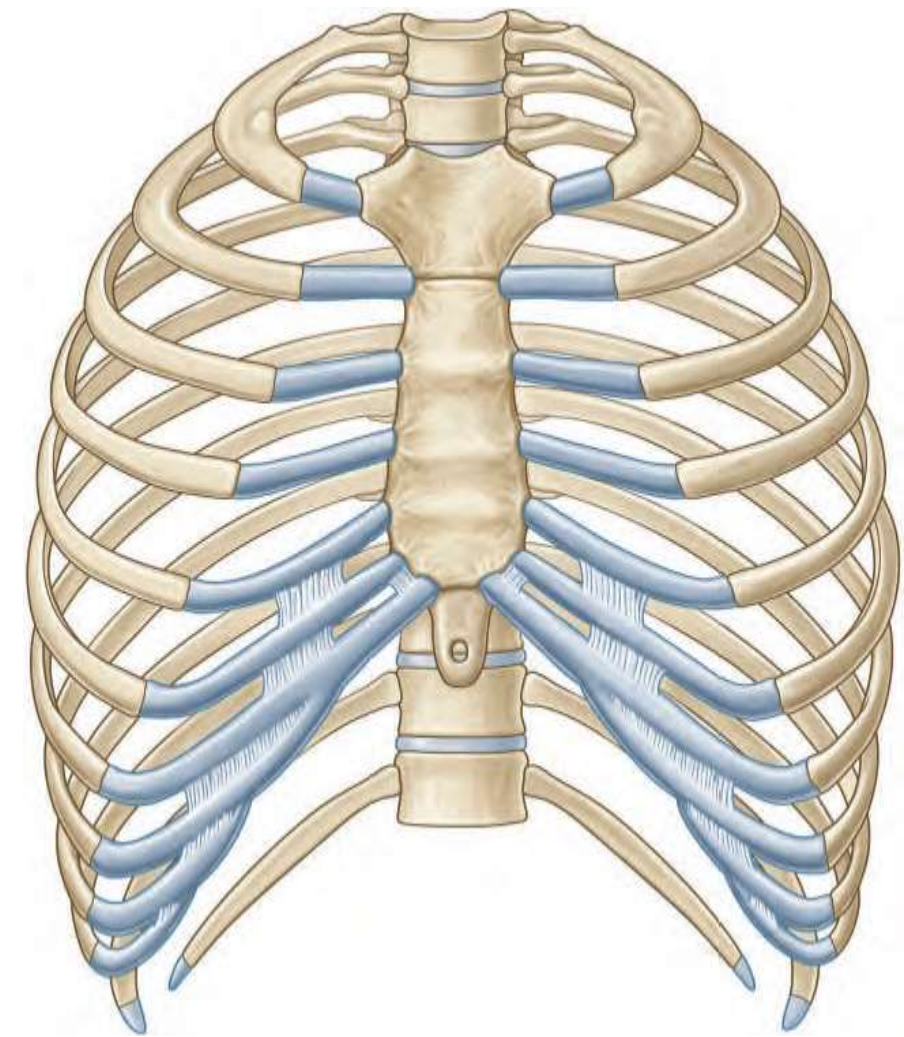


- ◆ Accesorial glands
- ◆ Rudiments - nipple
- ◆ Nipple and areola
- ◆ Gland without areola
- ◆ In axilla
- ◆ Axillary gland - Ca

MILK CREST

Thorax – bones and muscles

Prof. MUDr. Jiří Ferda, Ph.D.



- ♦ **Sternum**
- ♦ **Costae**
- ♦ **Costae verae (I - VII)**
- ♦ **Costae spuriae (VIII - X)**
- ♦ **Costae fluctulantes (XI, XII)**
- ♦ **Vertebrae Th1-12**



CHEST SKELETON



- ♦ **cordiform**

- ♦ *H. sapiens*

- ♦ *elipse - quadrupoda*

- ♦ **Newborn - conic**

- ♦ **adult – cylindric to barrel**

- ♦ **Barrel-like**

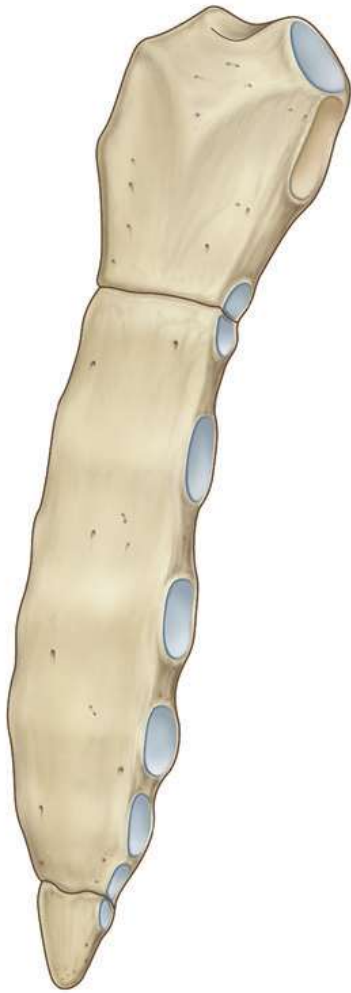
- ♦ **Asthenic**

- ♦ **Bird – like - prominent sternum**

- ♦ **Excavate sternum - pectus excavatus**

- ♦ **Rachitic**

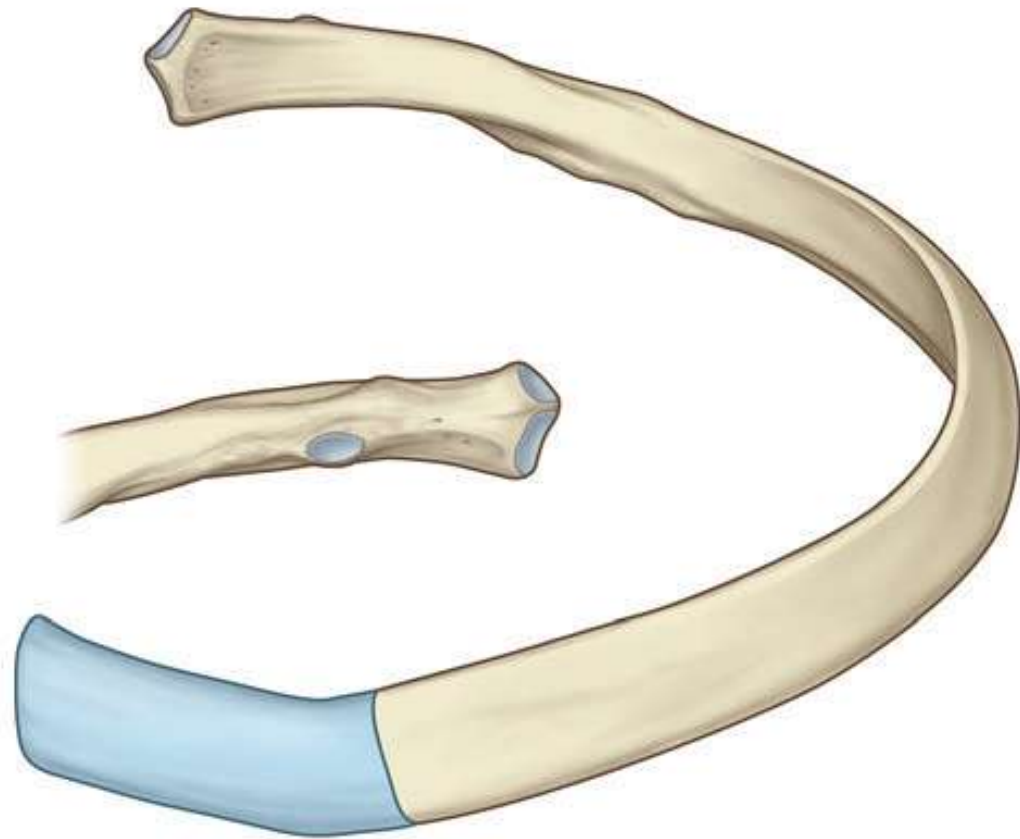
CHEST CAGE SHAPE



- ♦ **Incissura jugularis**
- ♦ **Manubrium**
 - ♦ **Facies articularis claviculae**
 - ♦ **Incisura costalis I**
 - ♦ **Incissura costalis II**
- ♦ **Angulus**
 - ♦ **Art. manubriosternalis - symphysis**
 - ♦ **Th4/5**
- ♦ **Corpus**
 - ♦ **Incissurae costales II - VII**
- ♦ **Processus xiphoideus**
 - ♦ **Art. xiphisternalis - symphysis**
 - ♦ **Incissura costalis VII**



STERNUM



♦ **Caput**

- ♦ **Facies articularis superior**
- ♦ **Facies articularis inferior**

♦ **Collum**

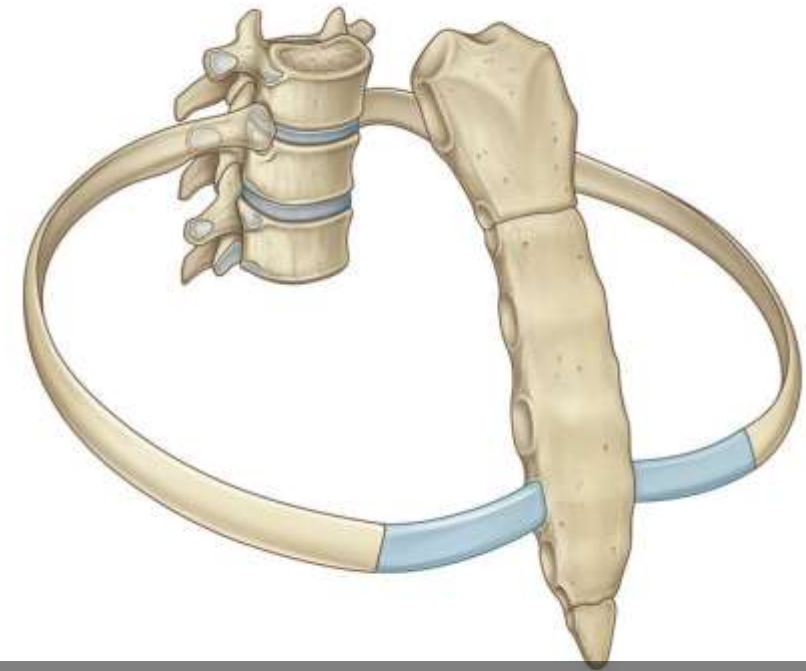
♦ **Tuberculum**

♦ **Facies articularis tuberculi costae**

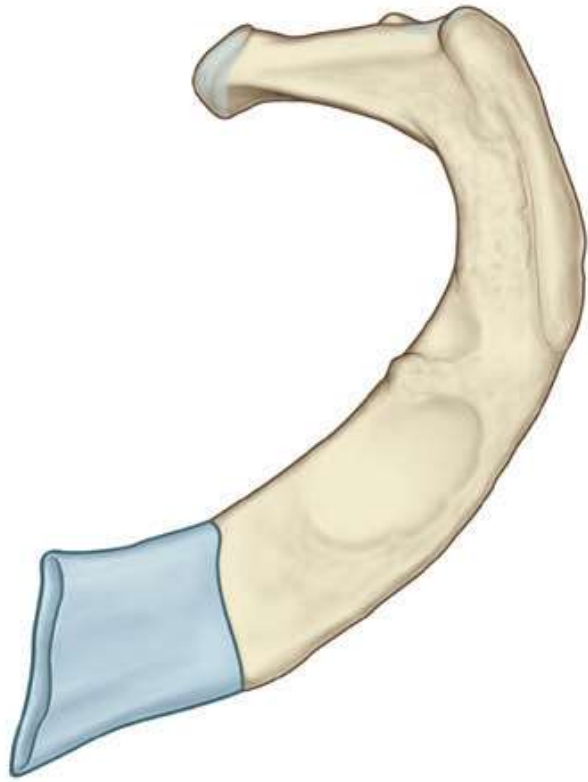
♦ **Angulus**

♦ **Sulcus costae**

♦ **Cartilago costalis**



COSTAE

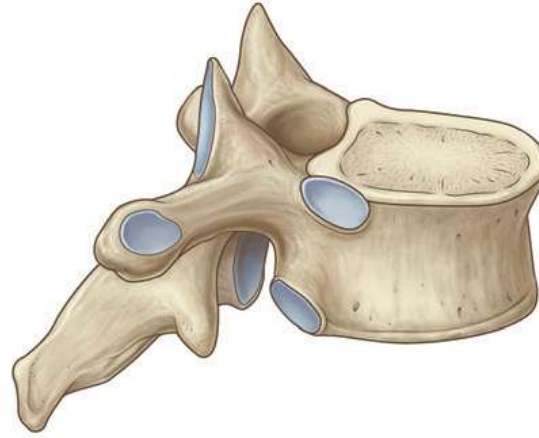


- **Costa I**
- **Caput**
 - **Facies articularis**
- **Collum**
- **Tuberculum**
 - **Facies articularis tuberculi costae**
- **Sulcus a. subclaviae**
- **Tuberculum scalenum**
 - **M. scalenus medius**
- **Sulcus v. subclaviae**
- **Sulcus costae**
- **Cartilago costalis**

- **Costa XI, XII**
- **Caput**
- **Sulcus costae**
- **Cartilago costalis**



COSTA I, COSTA XI+XII



♦ Th1-8 (9)

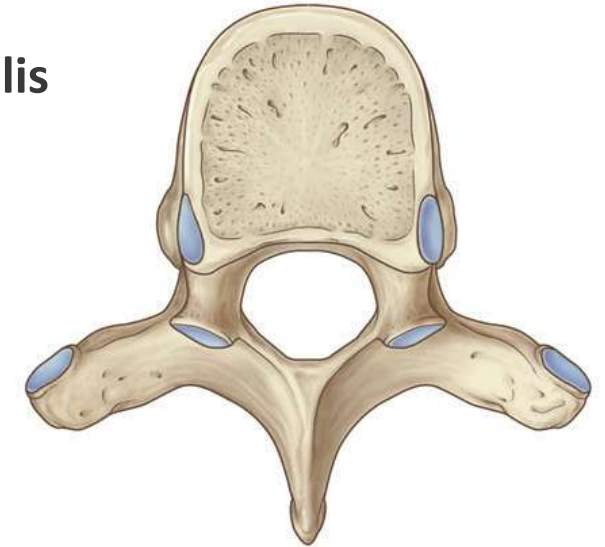
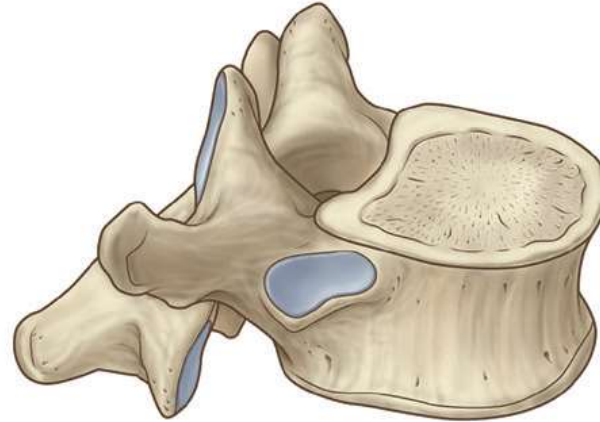
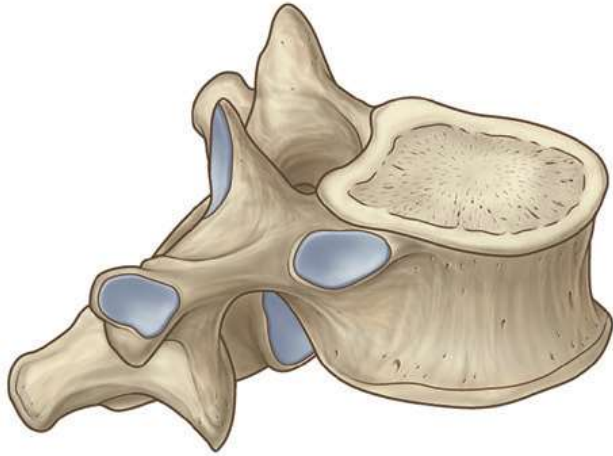
- ♦ Facies costalis superior
- ♦ Facies costalis inferior
- ♦ Fovea costalis proc. transvers

♦ Th (9) 10

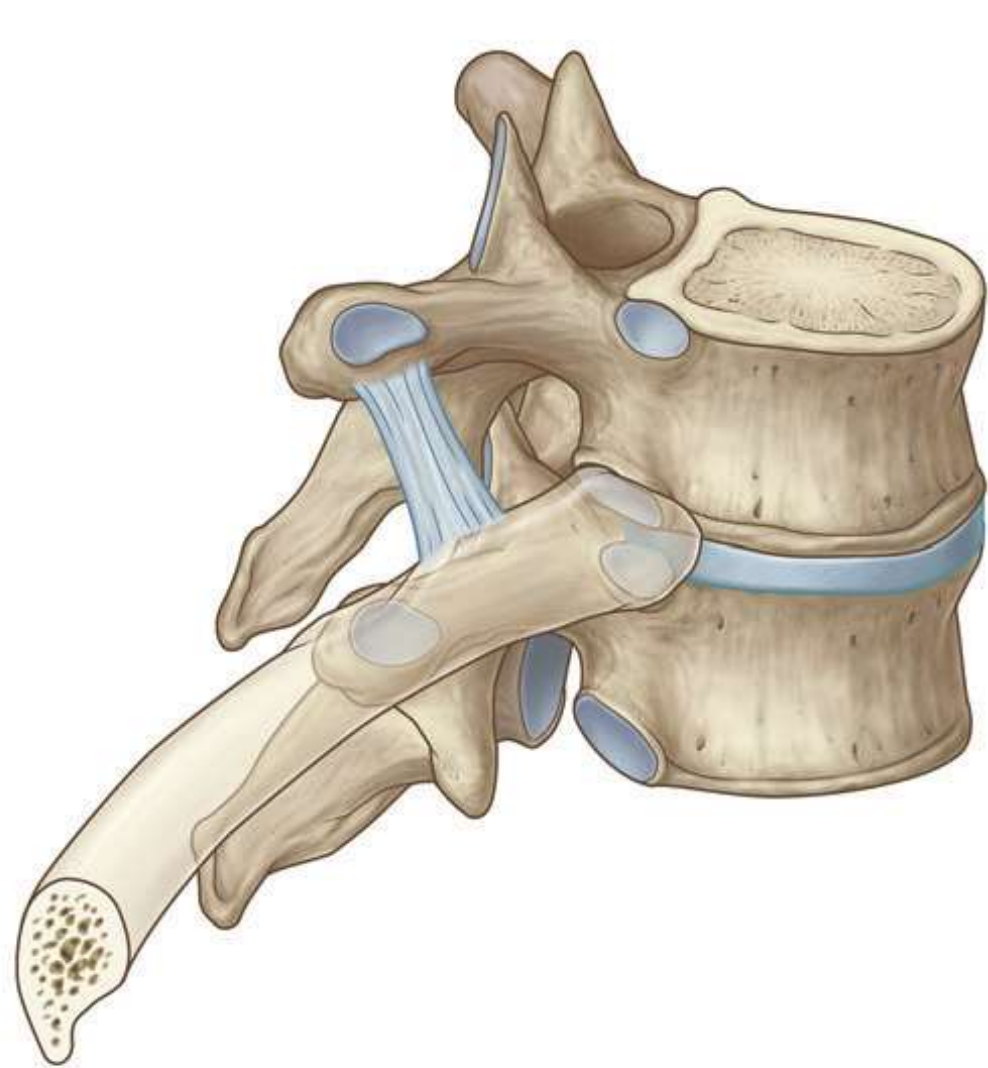
- ♦ Facies costalis
- ♦ Fovea costalis proc. transvers

Th 11, 12

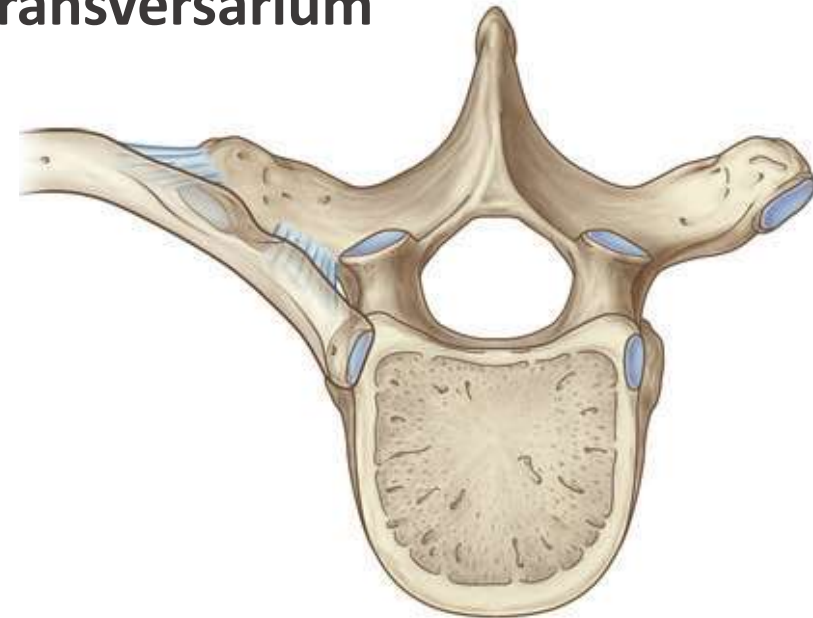
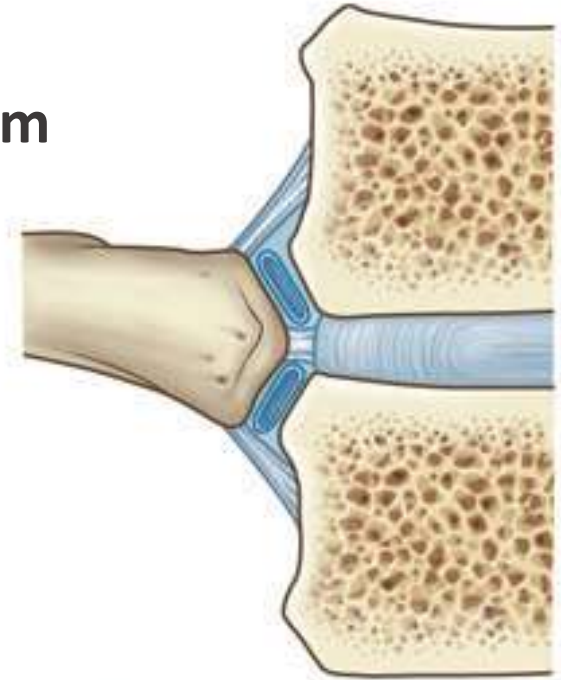
- ♦ Facies costalis



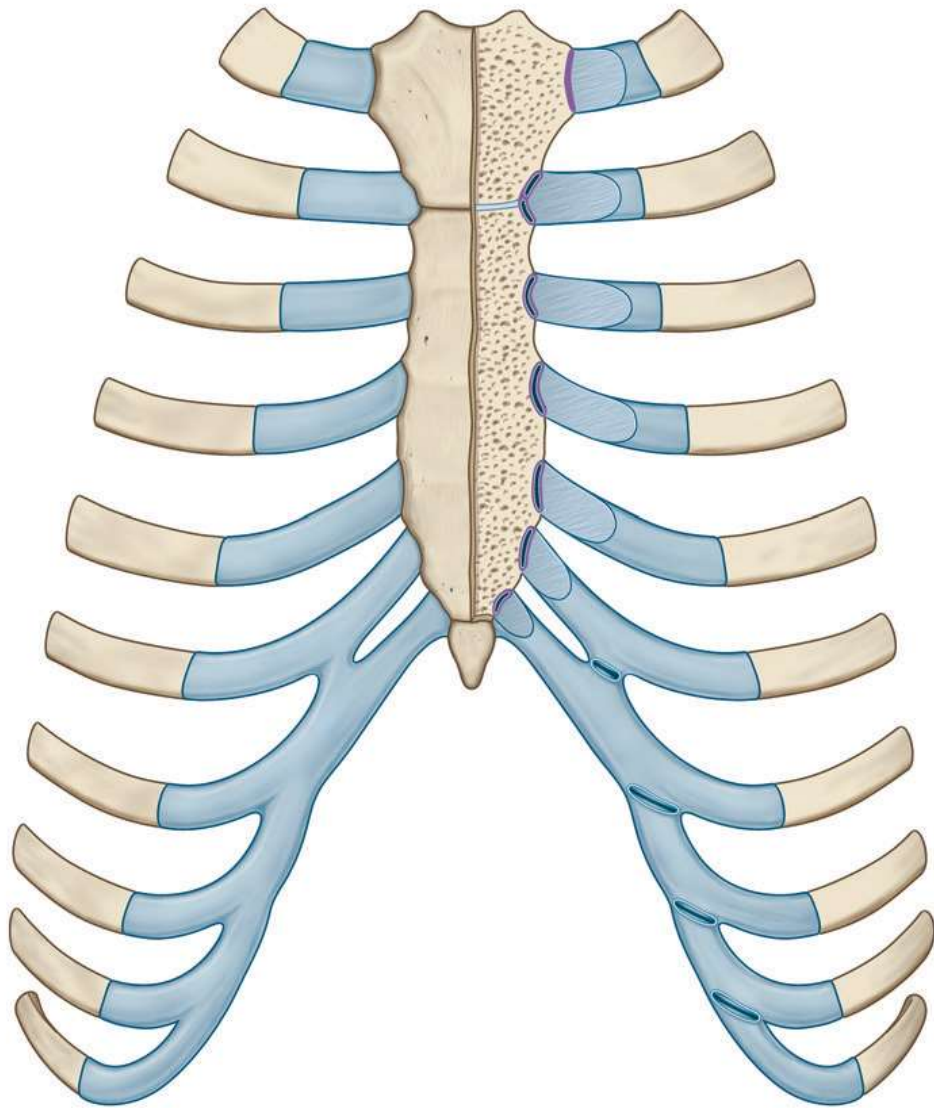
VERTEBRAE



- Ligamentum capitis costae radiatum
 - Capsula
- Lig. intraarticulare
- Lig. costotransversarium superius
- Lig. costotransversarium laterale
- Lig. costotransversarium



ART. COSTOVERTEBRALES



♦ Costa I

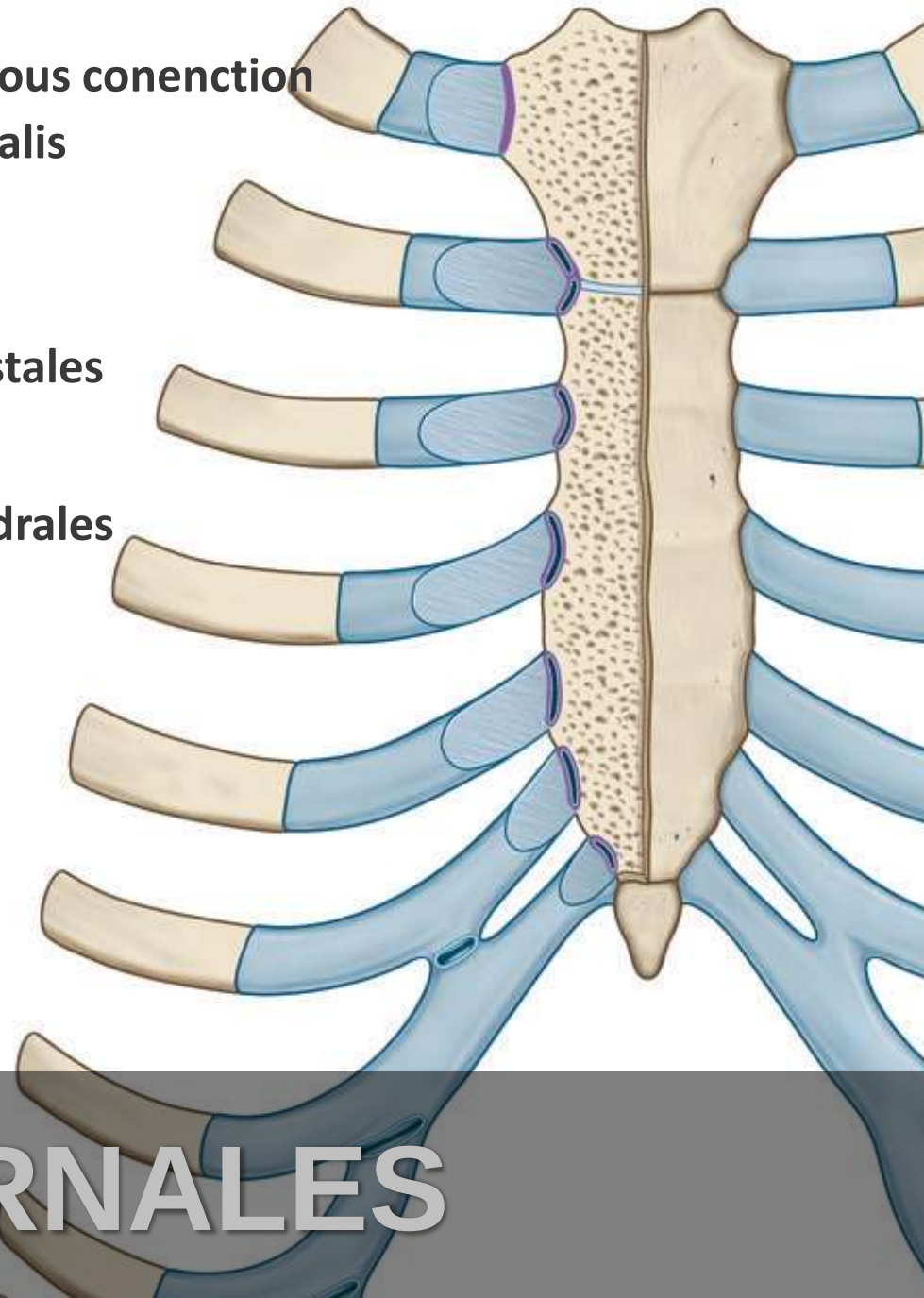
- ♦ Fibrocartilaginous connection
- ♦ Lig. sternocostalis

♦ Costa II - VII

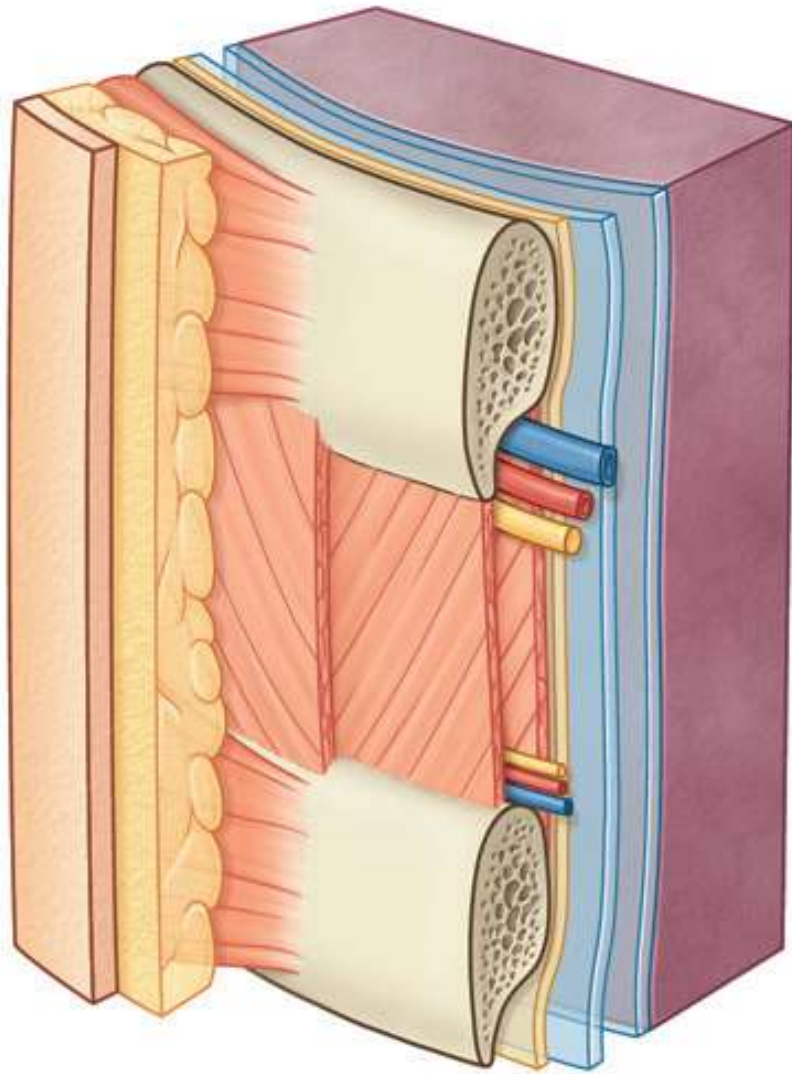
- ♦ Synovial joints
- ♦ Ligg. sternocostales

♦ Costa VIII-X

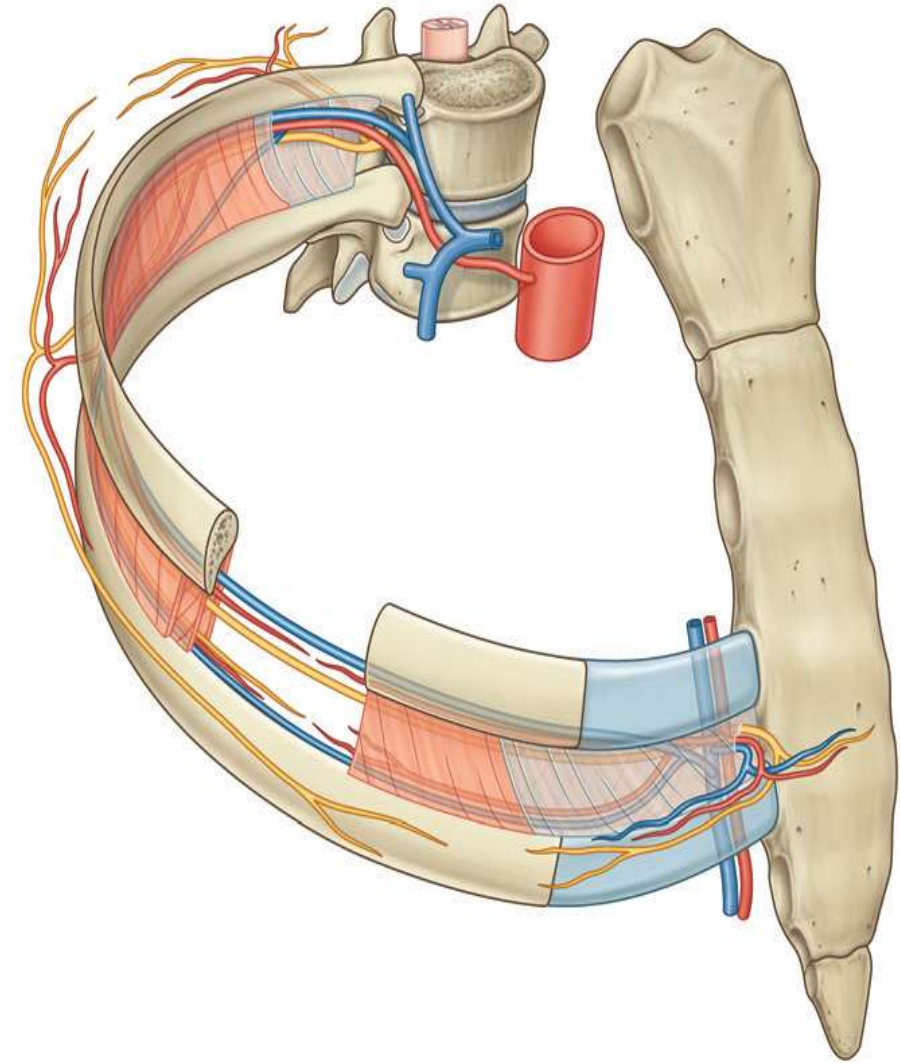
- ♦ Art. interchondrales
- ♦ Synovial joint



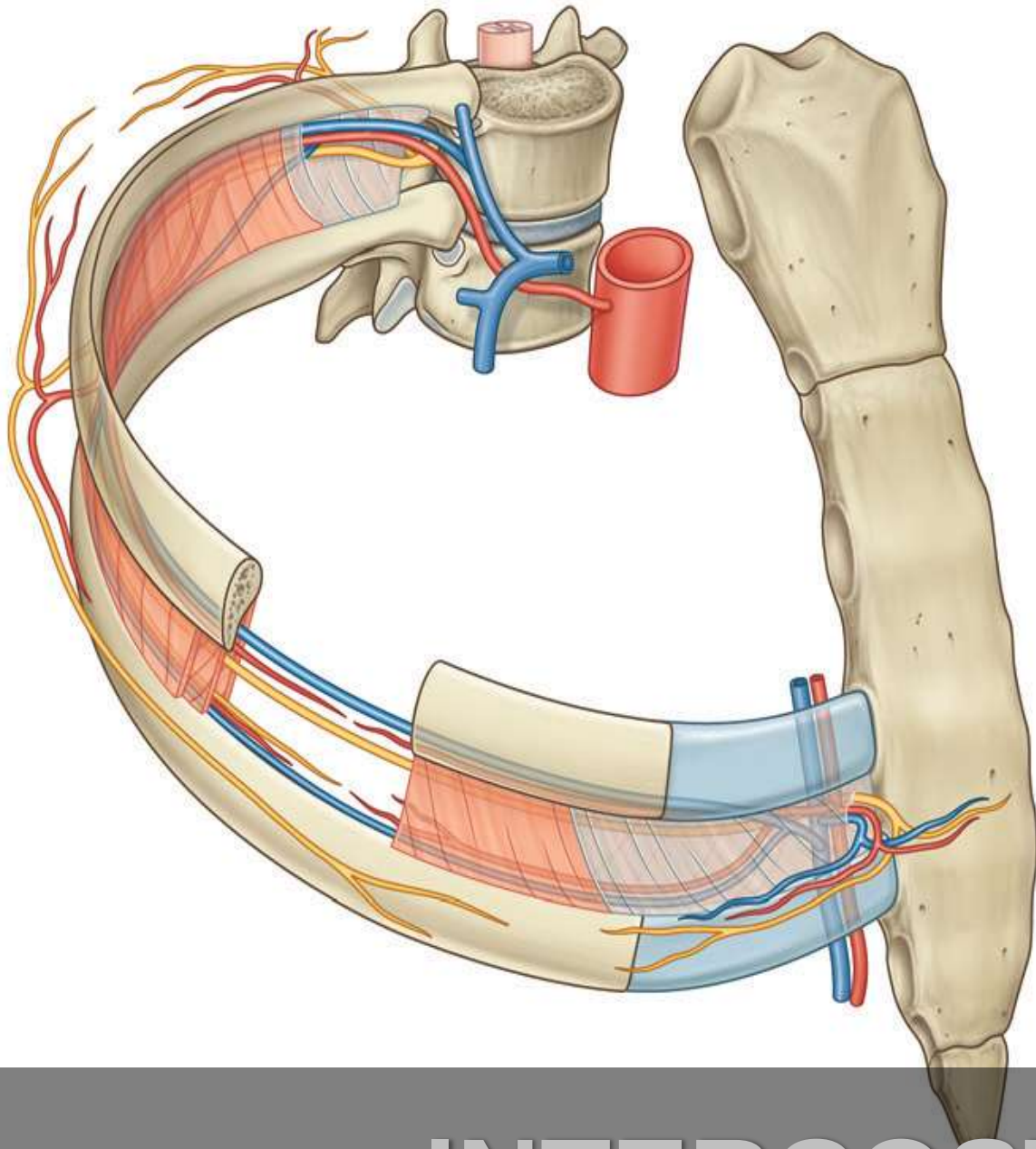
ART. COSTOSTERNALES



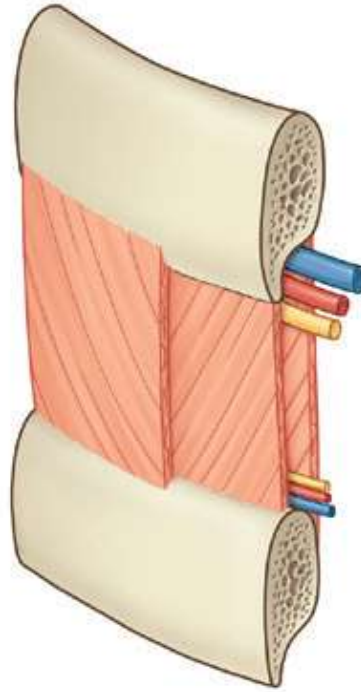
- ♦ skin
- ♦ M. serratus anterior
- ♦ M. intercostalis externus
- ♦ M. intercostalis internus
- ♦ Vasa et n. intercostales
 - ♦ *Vasa intercostales post, ant*
 - ♦ *Rami collaterales*
 - ♦ *Rami cutanei laterales*
- ♦ M. intercostalis intimus
- ♦ Fascia endothoracica
- ♦ Pleura parietalis
- ♦ Pleura visceralis
- ♦ Parenchyma pulmonis



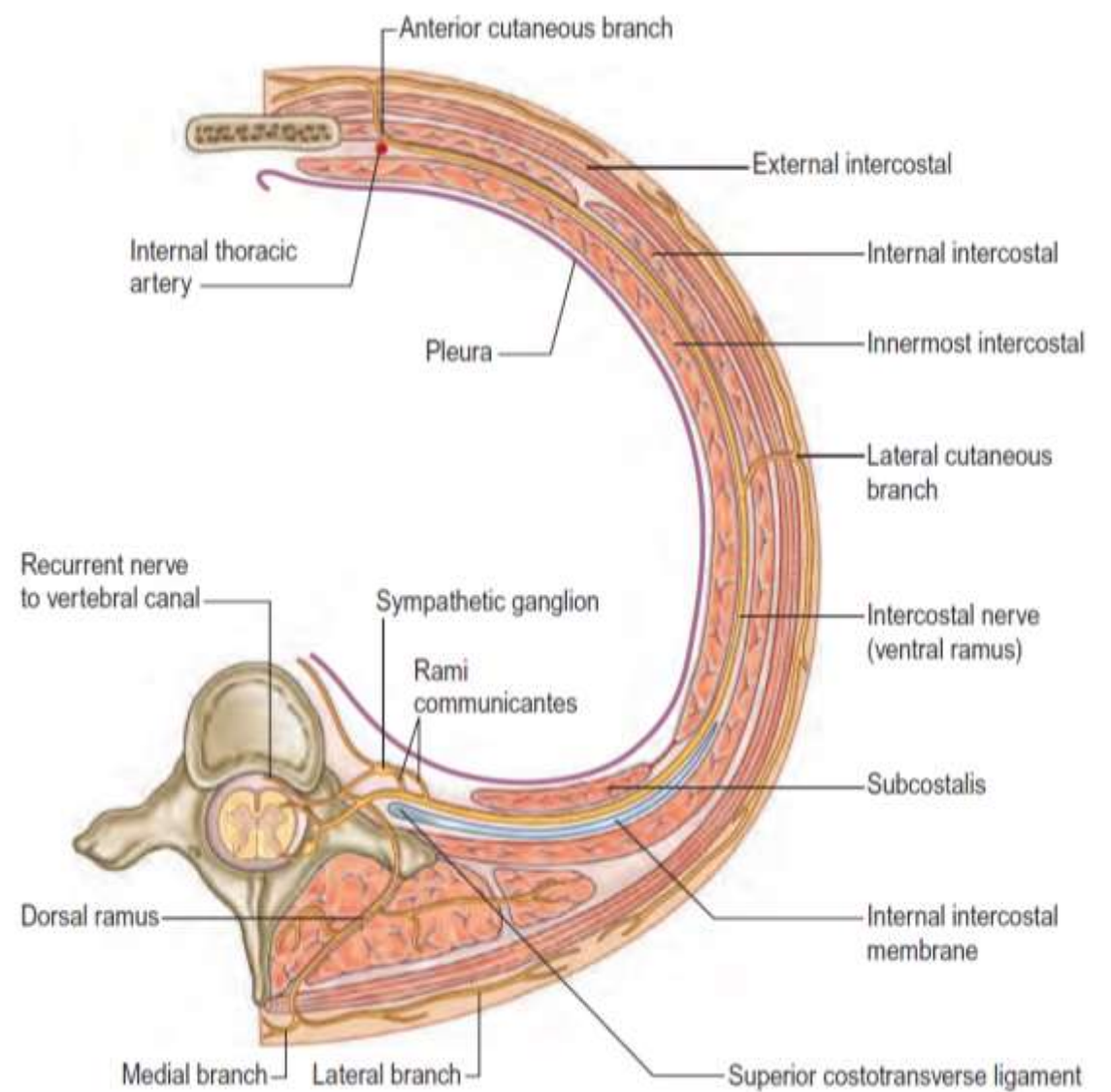
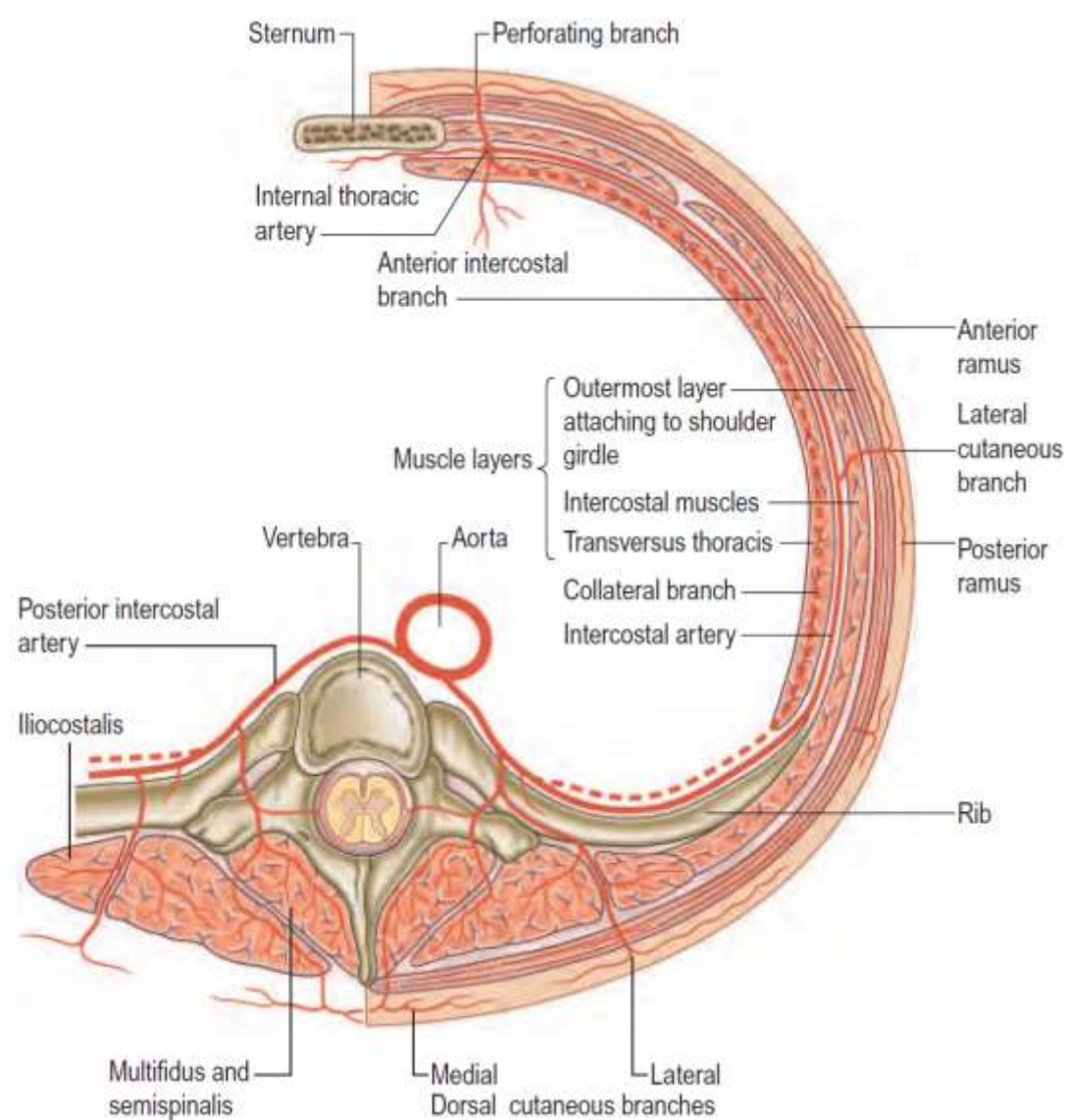
INTERCOSTAL SPACE



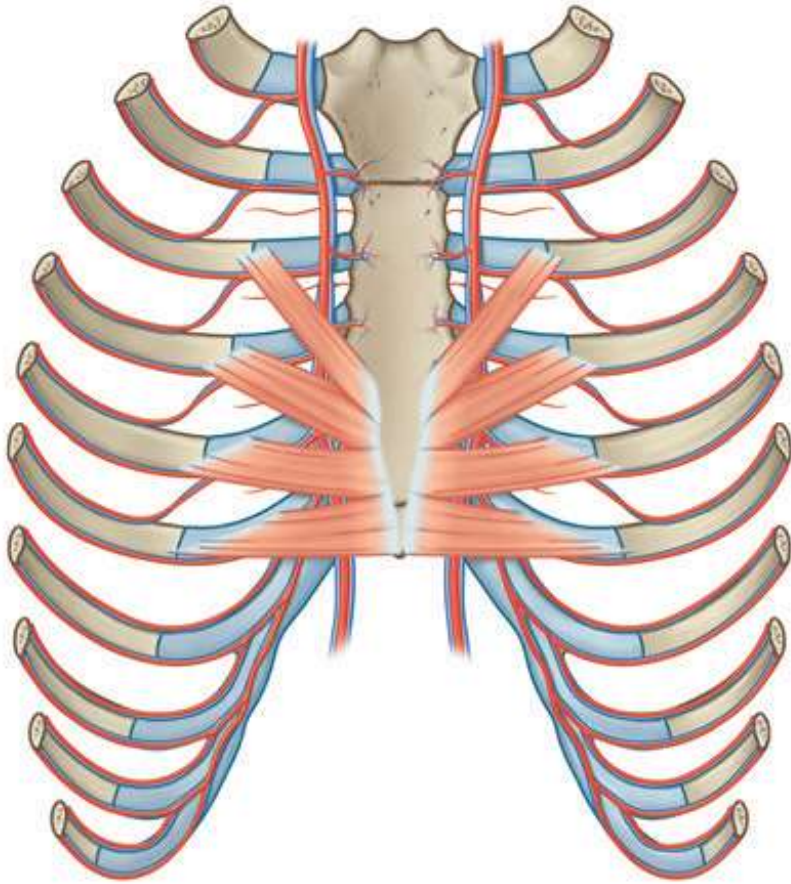
- ♦ **Mm. intercostales externi**
 - ♦ Inspiration muscles
 - ♦ Dorsocranial - ventrocaudal
 - ♦ From dorsal to ventral
- ♦ **Membrana intercostalis externa**
 - ♦ cartilago costae to sternum
- ♦ **Mm. intercostales interni**
 - ♦ Expiration muscles
 - ♦ Ventrocranial - dorsocaudal
 - ♦ From anterior to dorsal
- ♦ **Membrana intercostalis interna**
 - ♦ angulus costalis to vertebral column
- ♦ **Mm. intercostales intimi**
 - ♦ Covering from internal neurovascular bundle
 - ♦ function m.i.i.



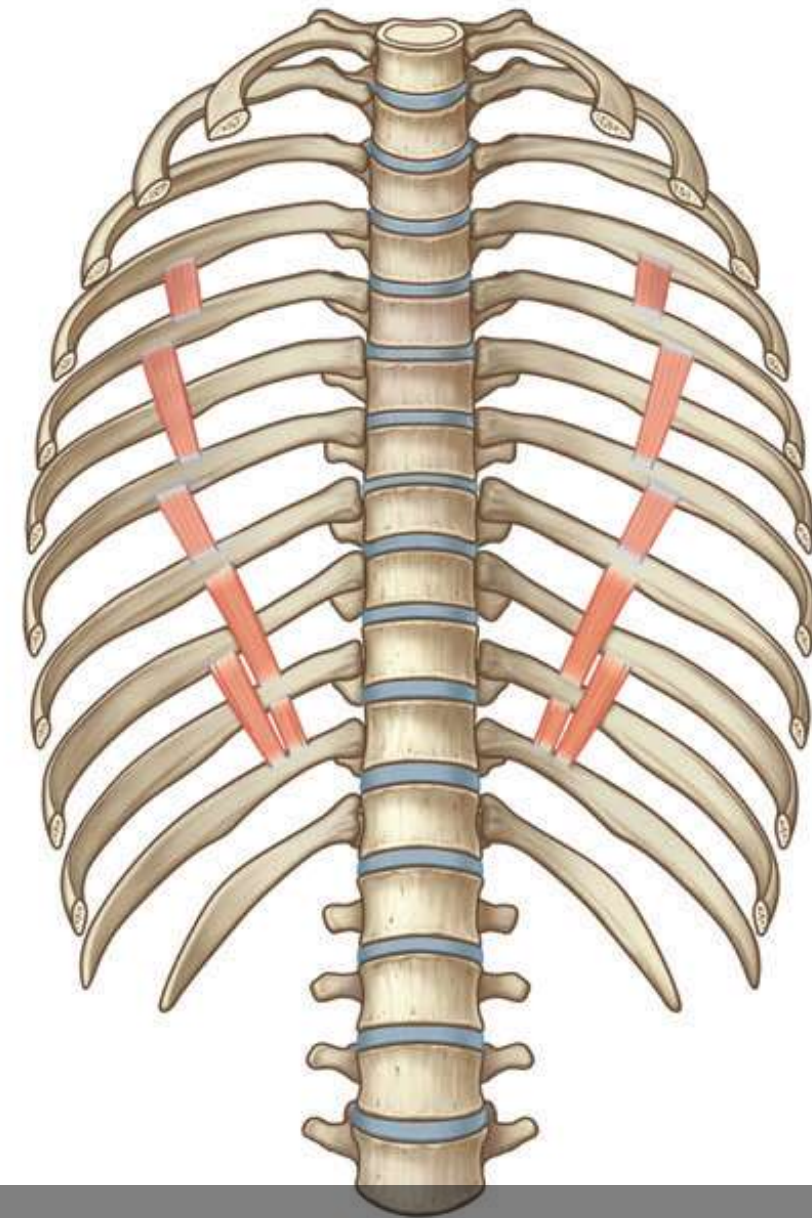
INTERCOSTAL MUSCLES



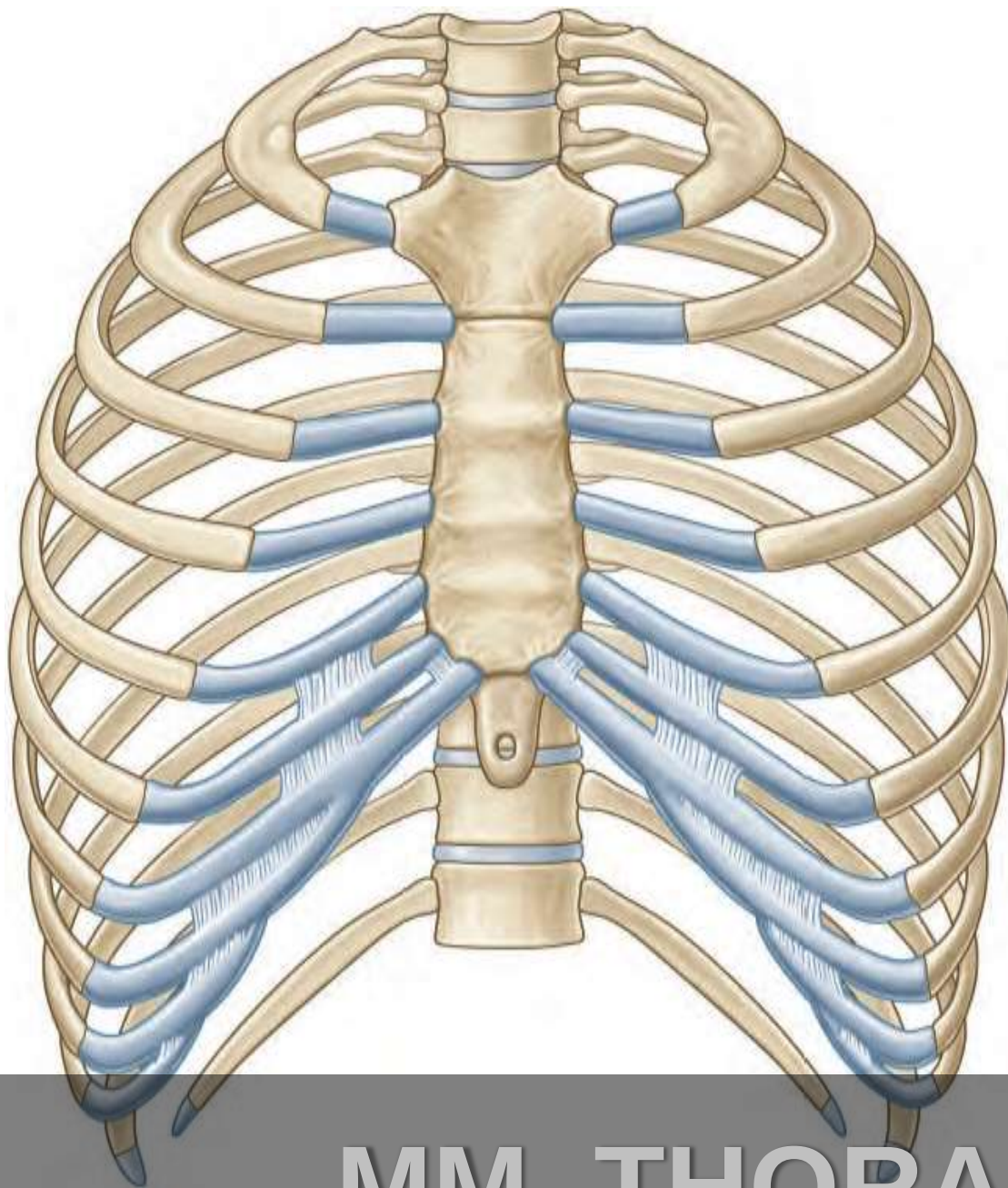
INTERCOSTAL VESSELS AND NERVES



- ♦ **inspiration**
- ♦ **Mm. intercostales externi**
- ♦ **expiration**
- ♦ **Mm. intercostales interni**
- ♦ **Mm. intercostales intimi**
- ♦ **Mm. subcostales**
 - ♦ dorsal
 - ♦ Between two or three ribs
 - ♦ Costa IV - costa XI
 - ♦ Push ribs down
- ♦ **M. transversus thoracis**
 - ♦ Sternum - costa III - VI
 - ♦ Movement of cartilages down



MM. THORACIS INTERNI



♦ Auxiliary inspiration

- ♦ M. sternocleidomastoideus - sternum
- ♦ M. subclavius - costa I
- ♦ M. scalenus anterior - costa I
- ♦ M. scalenus medius - costa I
- ♦ M. scalenus posterior - costa II
- ♦ Thorakohumerální svaly
- ♦ *M. serratus anterior* - costa I - VII
- ♦ *M. pectoralis minor* - costa III - V
- ♦ *M. pectoralis major* - sternum
- ♦ *M. serratus posterior superior*
- ♦ *M. serratus posterior inferior*

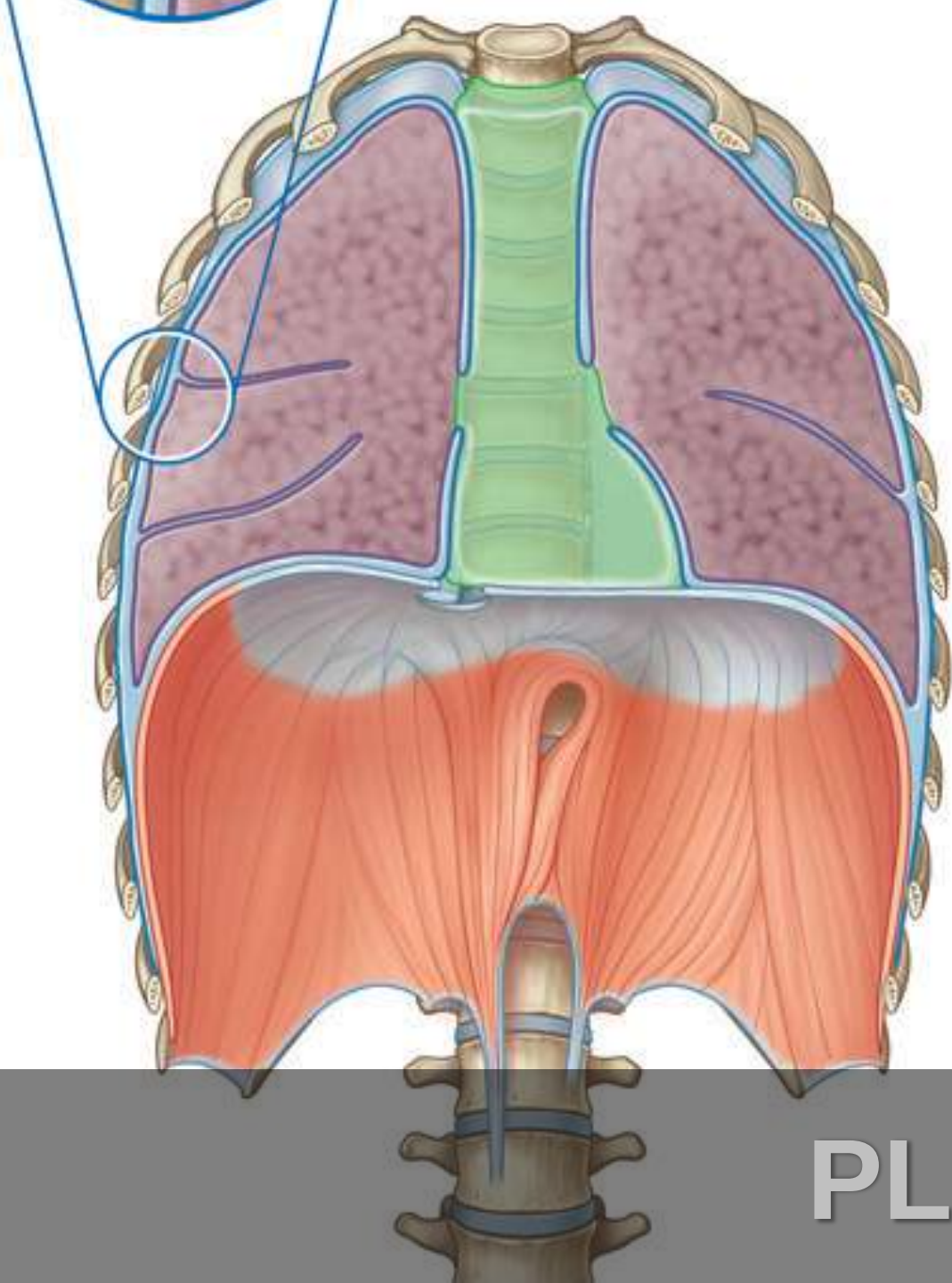
♦ Auxiliary expiration

- ♦ M. rectus abdominis - costa VI - VII
- ♦ Mm. dorsi

MM. THORACIS EXTERNI

Thorax – pleural cavity and diaphragm

Prof. MUDr. Jiří Ferda, Ph.D.

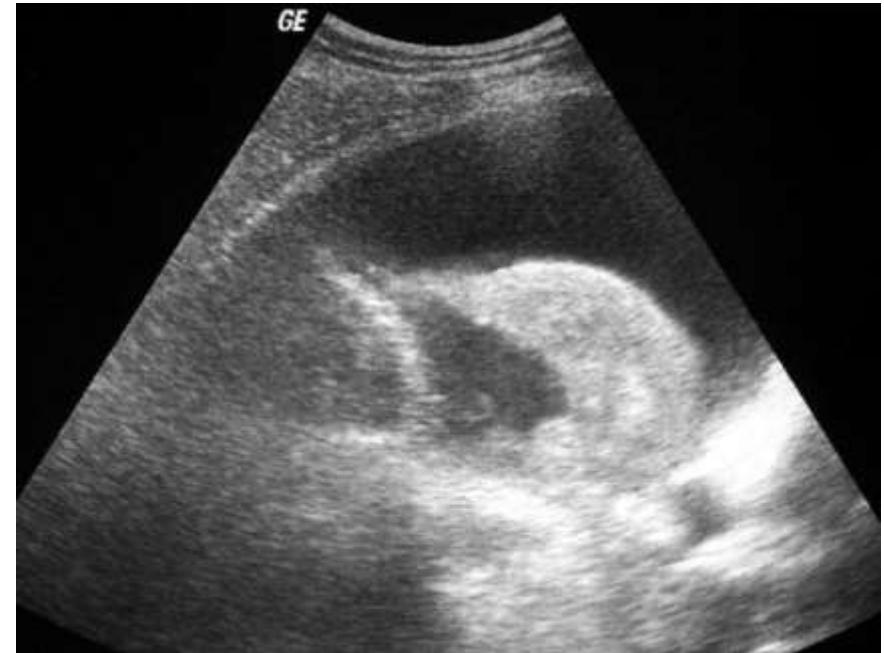


- ♦ **Pleura**
 - ♦ Mesothelia
 - ♦ Single layer of flat cells
 - ♦ Supporting connective tissue
- ♦ **Pleura parietalis**
 - ♦ Pars costalis
 - ♦ Pars diaphragmatica
 - ♦ Pars cervicalis (cupola)
 - ♦ Pars mediastinalis
- ♦ **Pleura visceralis**
 - ♦ On lung surface
- ♦ **Ligamentum pulmonale**
- ♦ **Cavitas pleuralis**

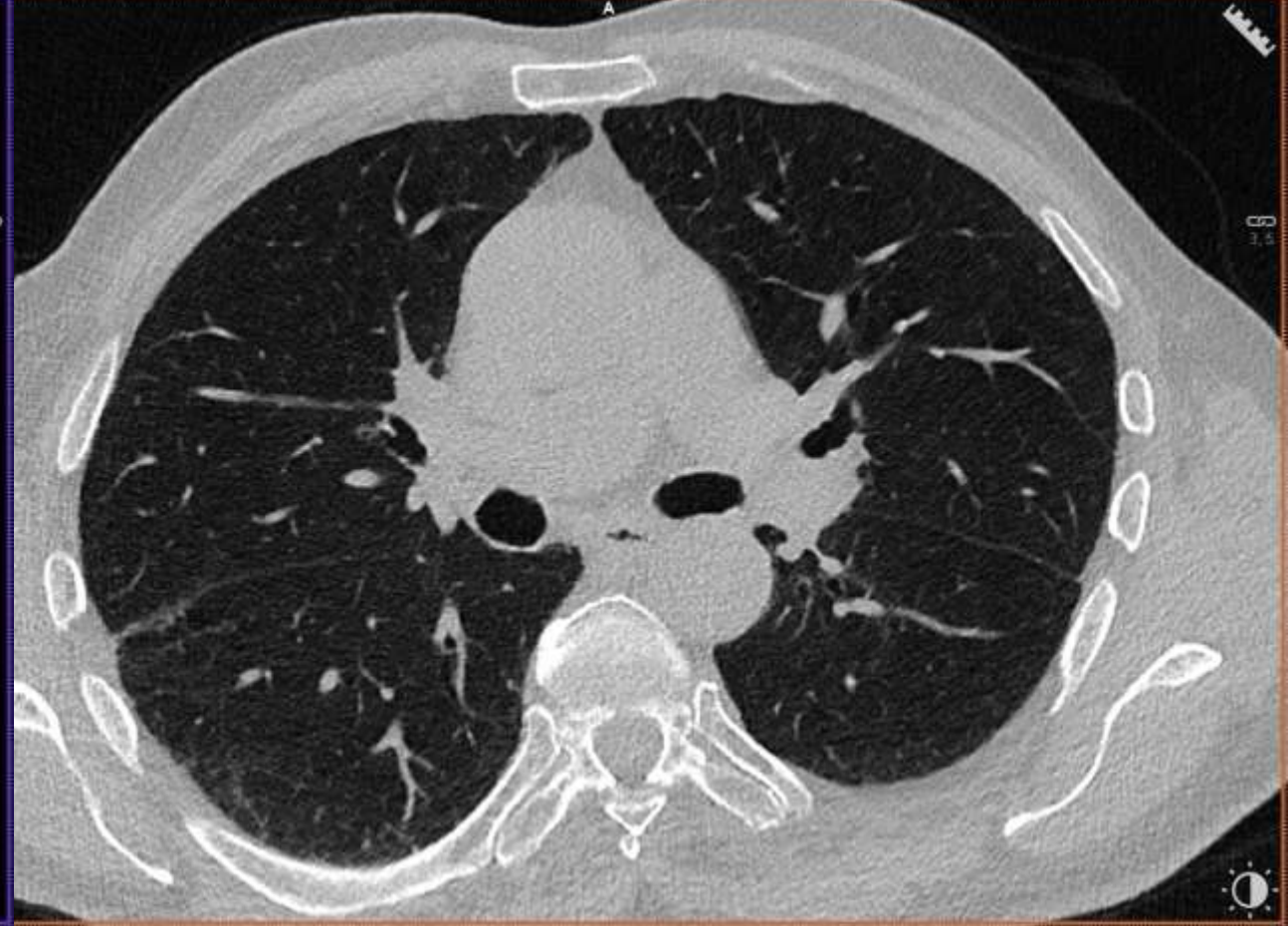
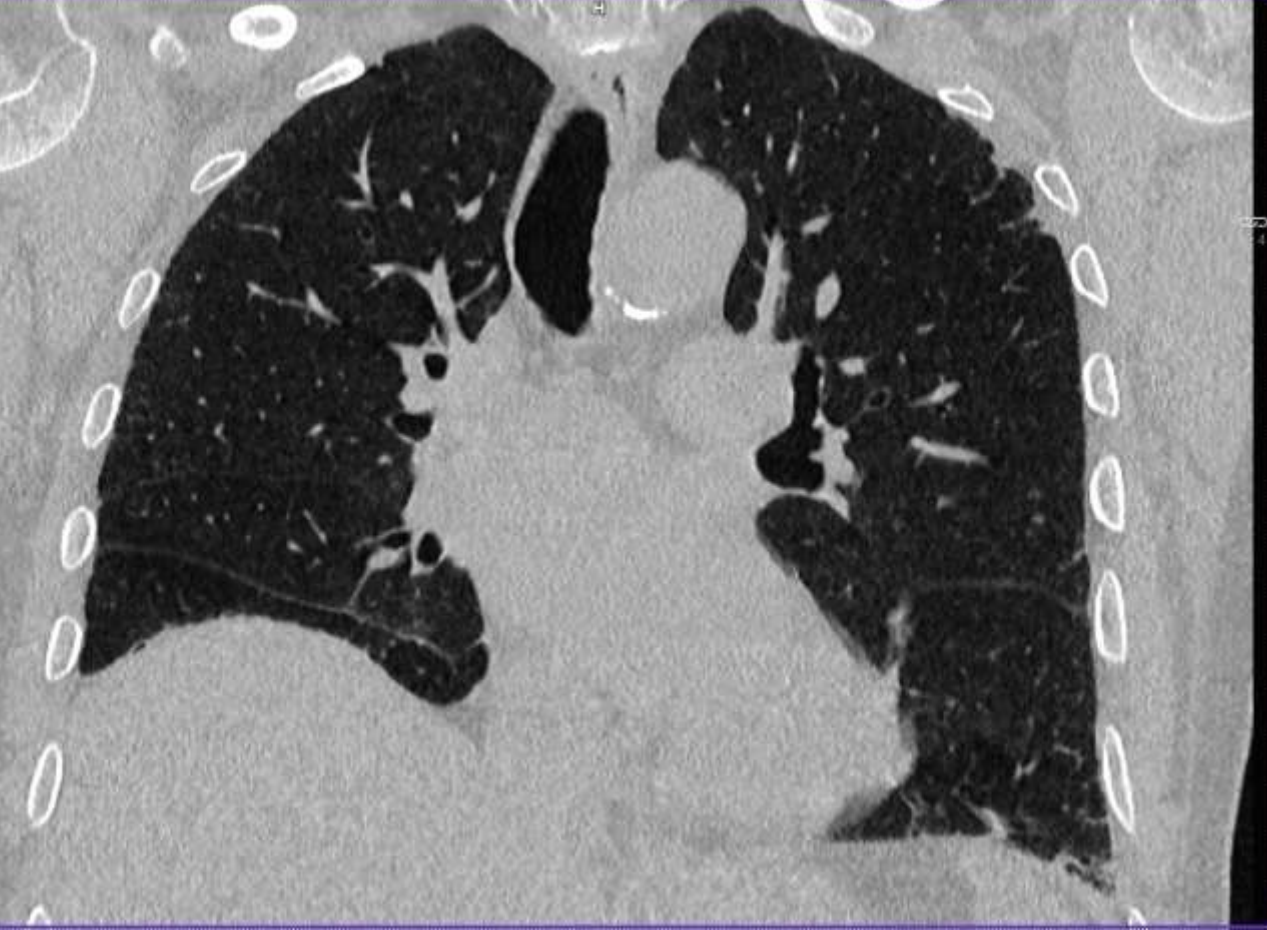
PLEURA



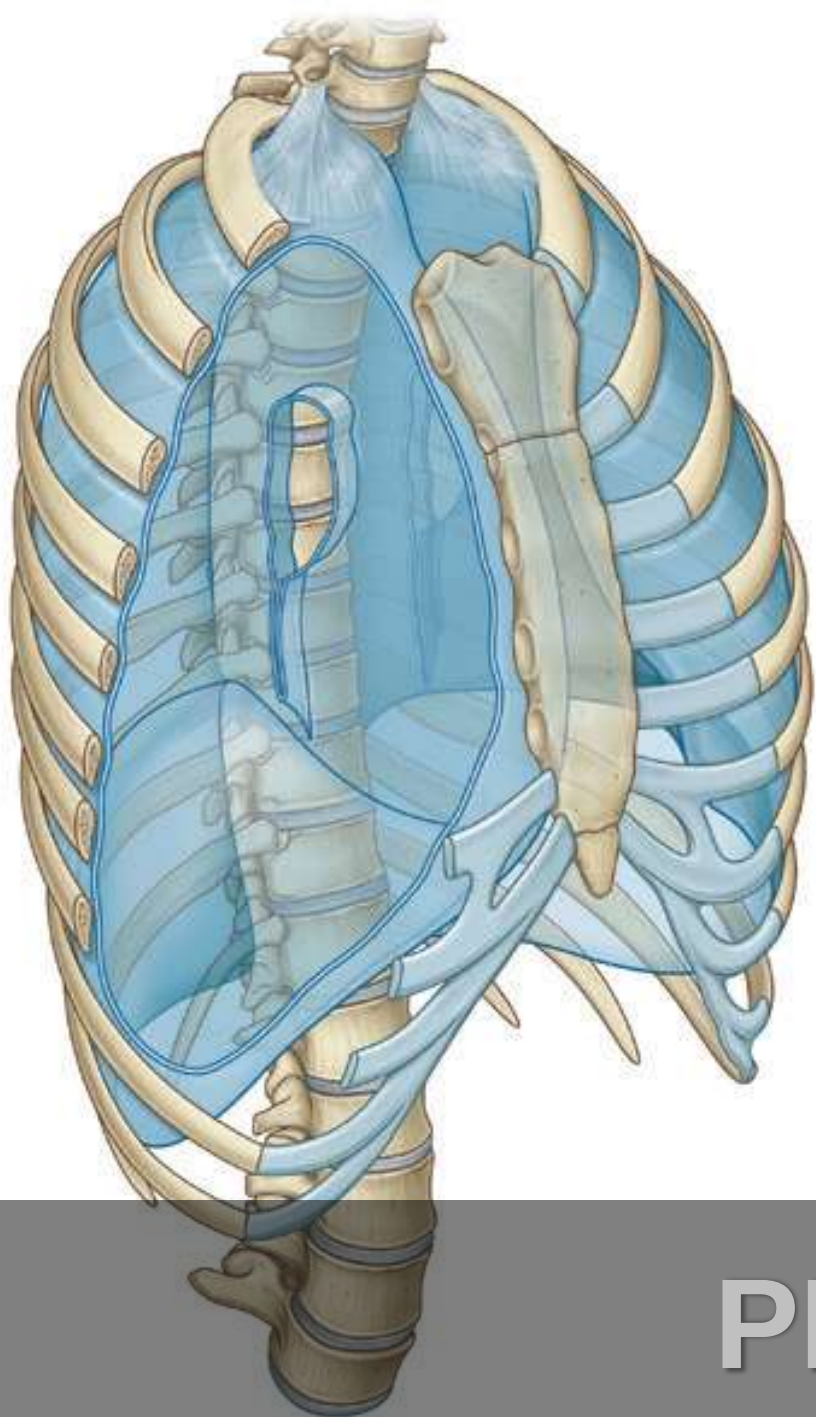
- ♦ **Recessus pleurales**
- ♦ Recessus costodiaphragmaticus
- ♦ Recessus costomediastinalis (dx. ant)
- ♦ Recessus paecardiacus (sin. ant.)
- ♦ Recessus retrooesophageus (dx. post.)



CAVITAS PLEURALIS

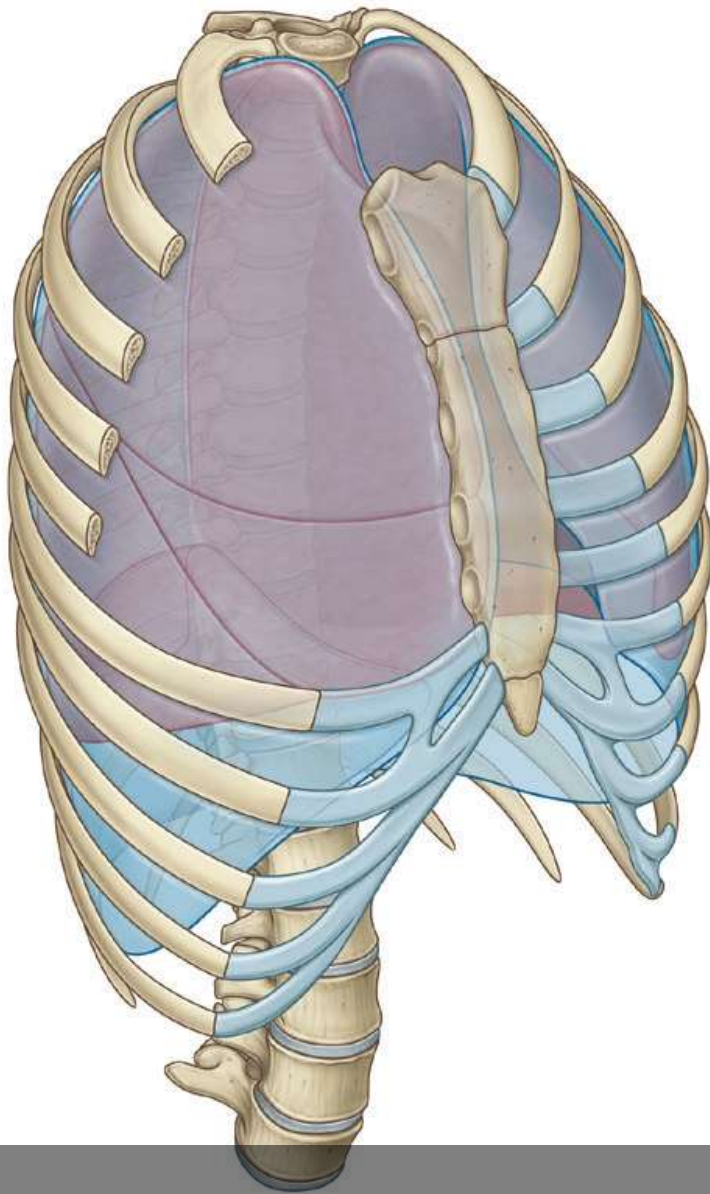


RECESSUS PLEURALES



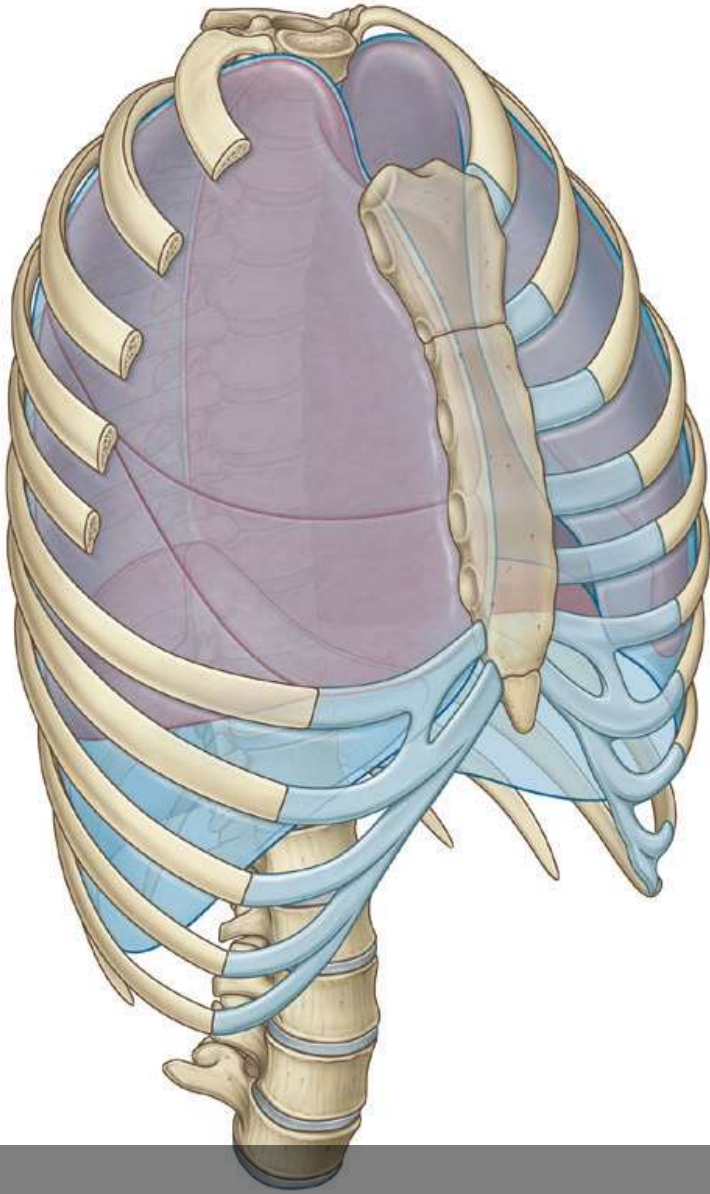
- ♦ **Membrana suprapleuralis**
- ♦ **Parietalis/visceralis**
- ♦ **Interface in „root“ of lung**
- ♦ **To hilum continues**
- ♦ **Pleura visceralis**
- ♦ **Parietalis/visceralis**
- ♦ **Ligamentum pulmonale**
- ♦ **Duplicature of parietal pleura**
- ♦ **Fixation of lung to mediastinum**

PLEURA



- | | lung | pleura |
|--|------|--------|
| ♦ <i>rib</i> | | |
| ♦ Medioclavicular line | VI | VII |
| ♦ mid-axillary line | VIII | IX |
| ♦ Scaular line | X | XI |
| ♦ Paravertebral line | XI | XII |
| ♦ Area thymica – cupula to II. rib | | |
| ♦ Anterior line of connection costa II - IV | | |
| ♦ Area perikardiaca costa IV - VI | | |
| ♦ Recessus oesophageus Th 4 - Th12 | | |
| ♦ To left from right | | |
| ♦ Cupula – pleural divergention Th 2 – to C7 | | |

PROJECTIONS OF PLEURA NAD LUNGS



- ♦ **Fissura interlobaris obliqua**

- ♦ **Processus spinosus Th3**

- ♦ **Cartilago costae VI**

- ♦ **Fissura interlobaris horizontalis**

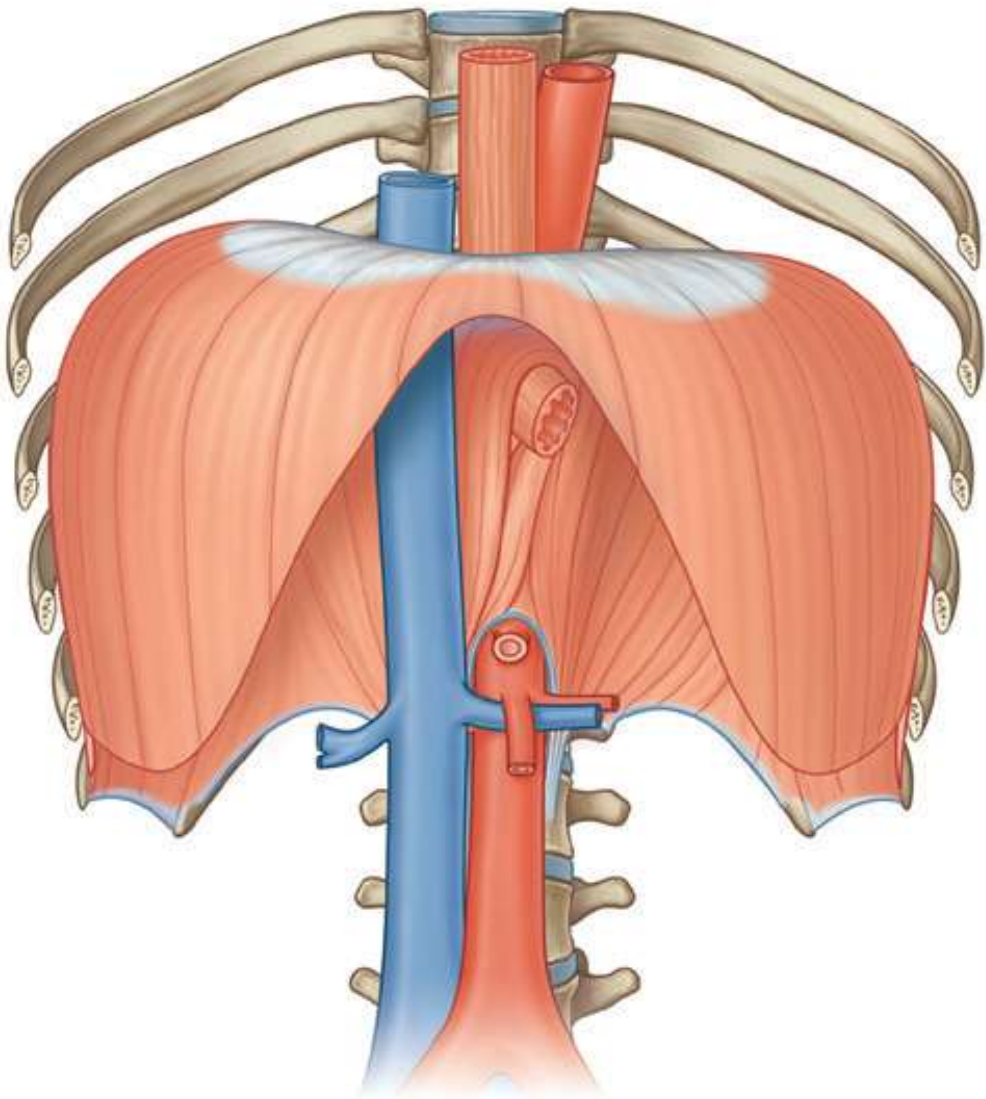
- ♦ **divides posterior axillary line**

- ♦ **along costa IV**

INTERLOBAR FISSURES

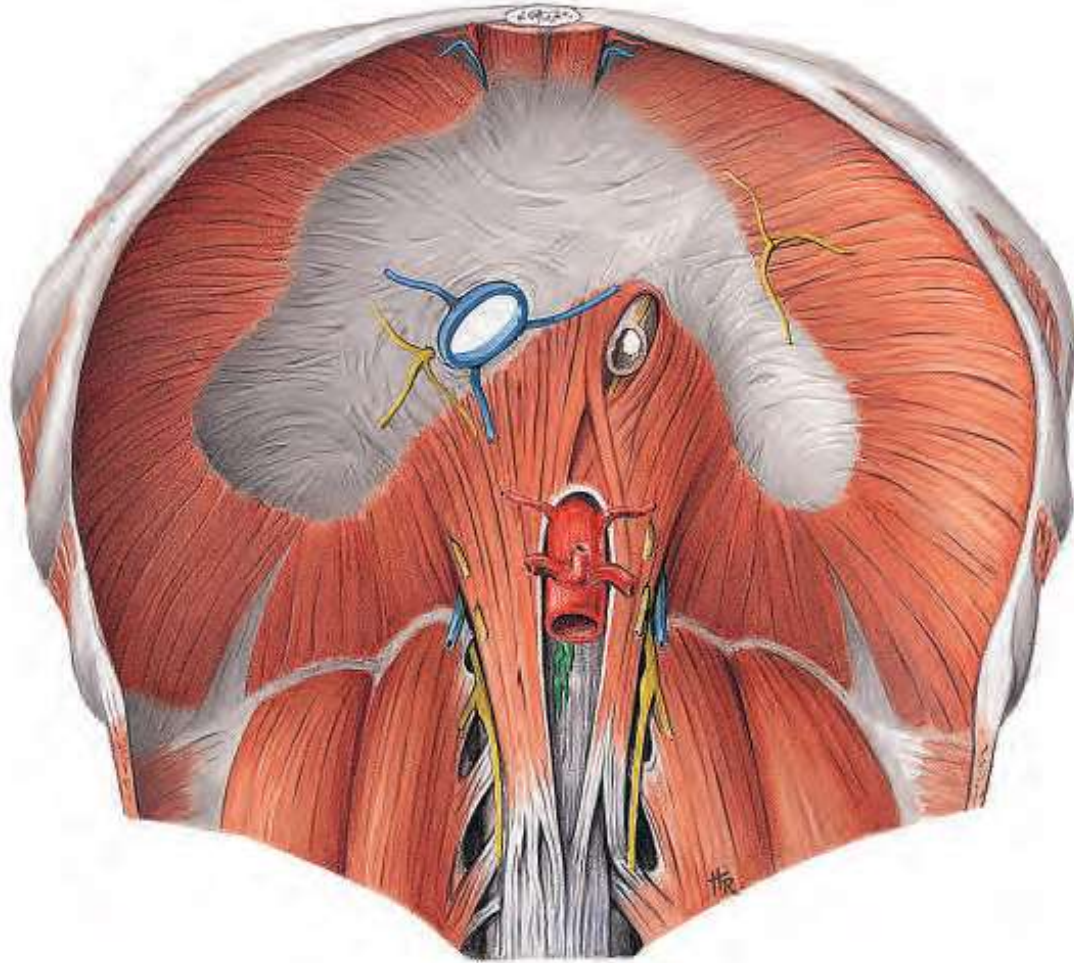


Tension pneumotorax



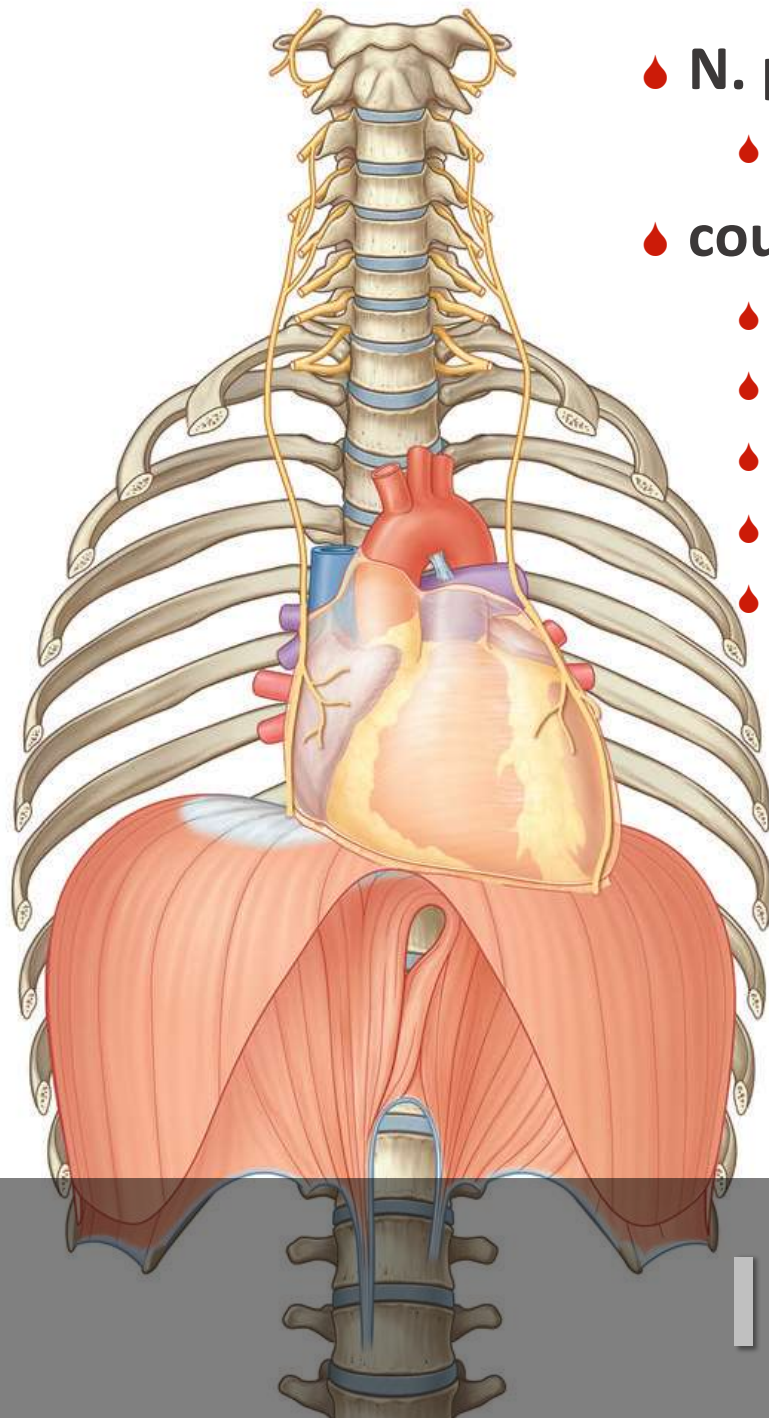
- ♦ **Centrum tendineum**
 - ♦ Foramen venae cavae - Th8
- ♦ **Pars sternalis**
 - ♦ Trigonum sternocostale (Morgagni)
- ♦ **Pars costalis**
 - ♦ Trigonum costolumbale (Bochdaleki)
- ♦ **Pars lumbalis**
 - ♦ Hiatus oesophagealis - Th10
 - ♦ Hiatus aorticus - Th12
- ♦ **Crura diaphragmatis - L3**
 - ♦ Lig. arcuatum, laterale dx., sin., medianum
- ♦ **Copula dextra (4. intercostal space)**
- ♦ **Copula sinistra (5. intercostal space)**

DIAPHRAGMA



- ♦ **Centrum tendineum**
 - ♦ Foramen venae cavae - Th8
- ♦ **Pars sternalis**
 - ♦ Trigonum sternocostale (Morgagni)
- ♦ **Pars costalis**
 - ♦ Trigonum costolumbale (Bochdaleki)
- ♦ **Pars lumbalis**
 - ♦ Hiatus oesophagealis - Th10
 - ♦ Hiatus aorticus - Th12
- ♦ **Crura diaphragmatis - L3**
 - ♦ Lig. arcuatum, laterale dx., sin., medianum
- ♦ **Copula dextra (4. intercostal space)**
- ♦ **Copula sinistra (5. intercostal space)**

DIAPHRAGMA



♦ **N. phrenicus (C3,C4,C5)**

♦ Plexus cervicalis

♦ **course**

♦ Vertical on the neck

♦ between v. subclavia a m. scalenus ant.

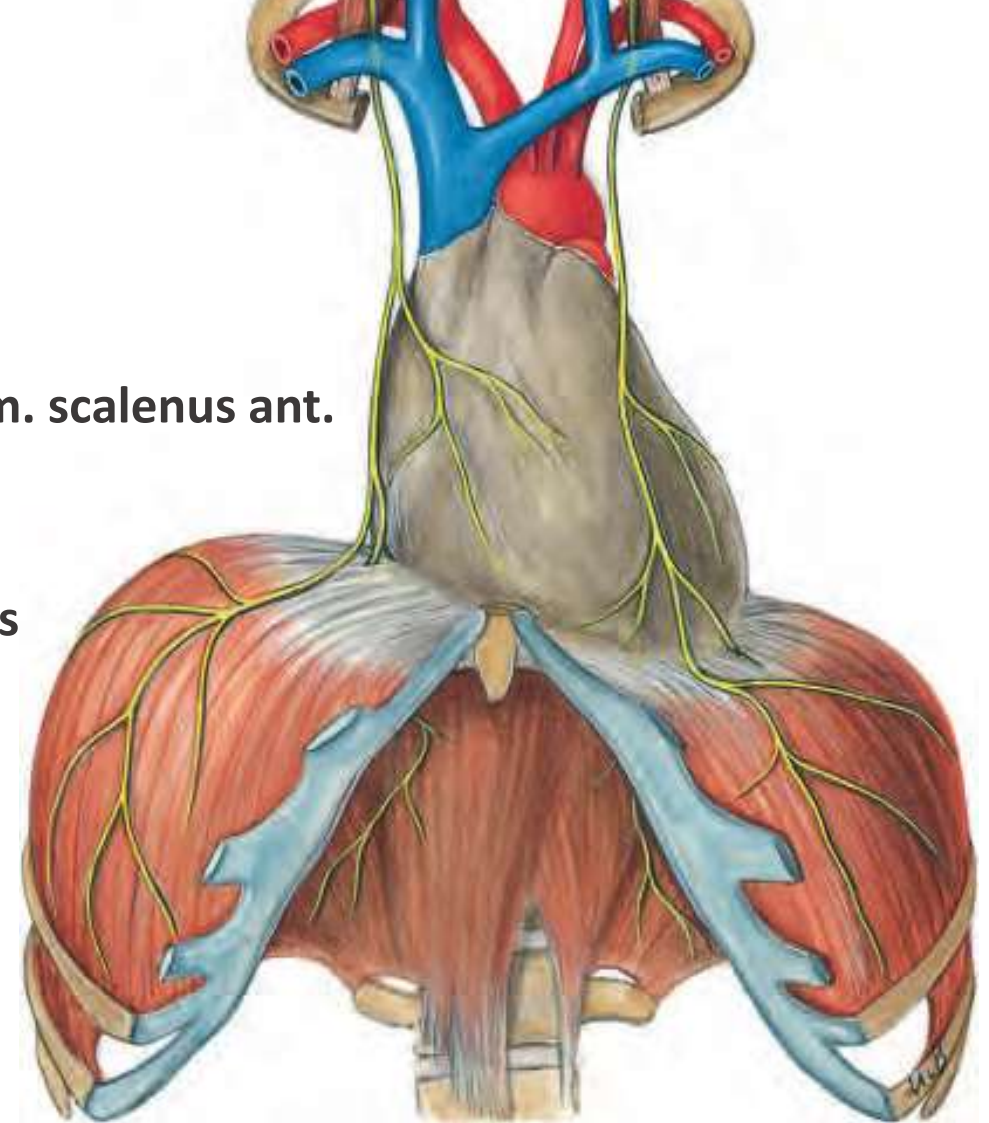
♦ In the front of hilus

♦ Rr. pericardiales

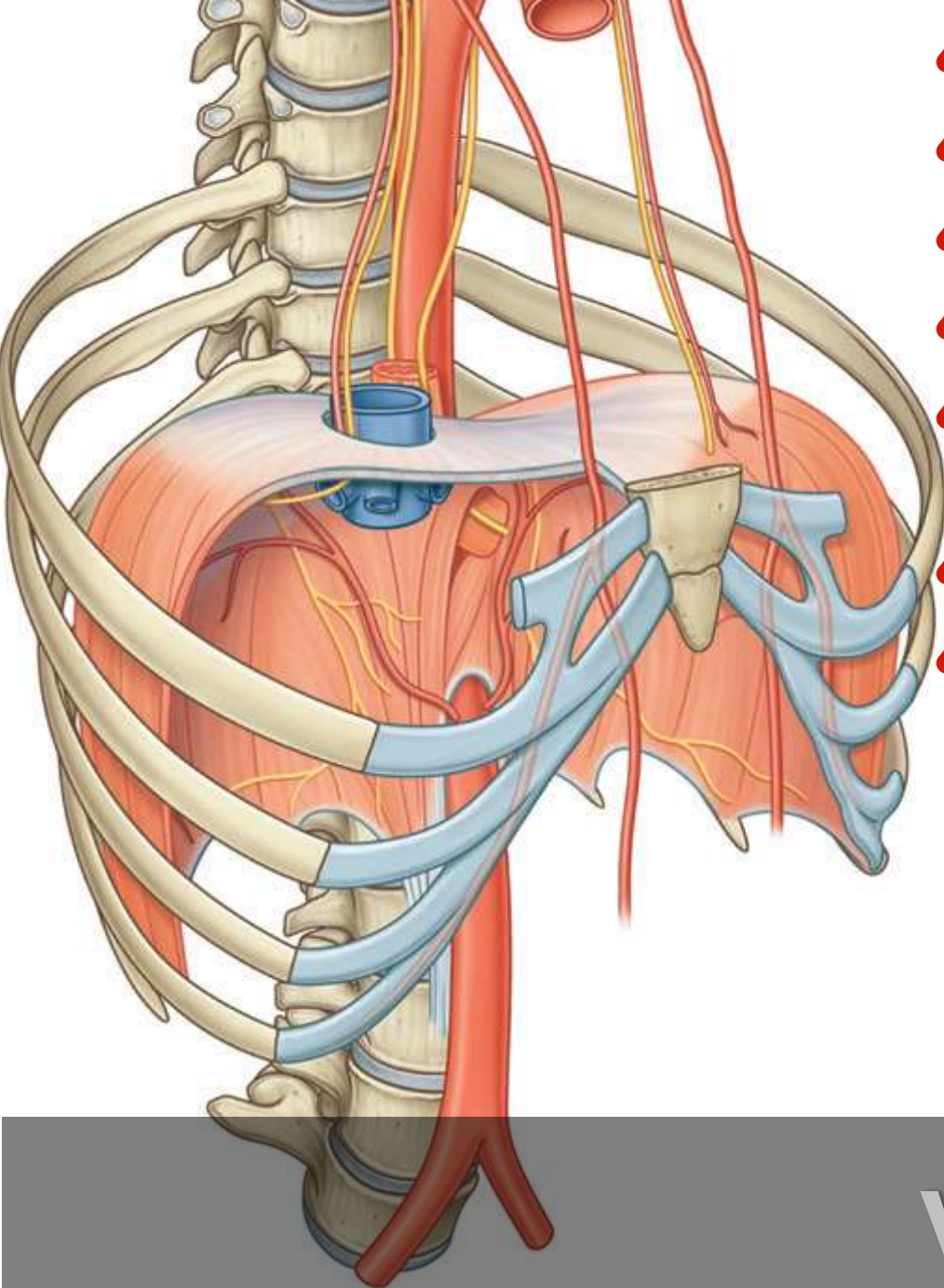
♦ Rr. phrenicoabdominales

♦ Dx. - foramen v. cavae

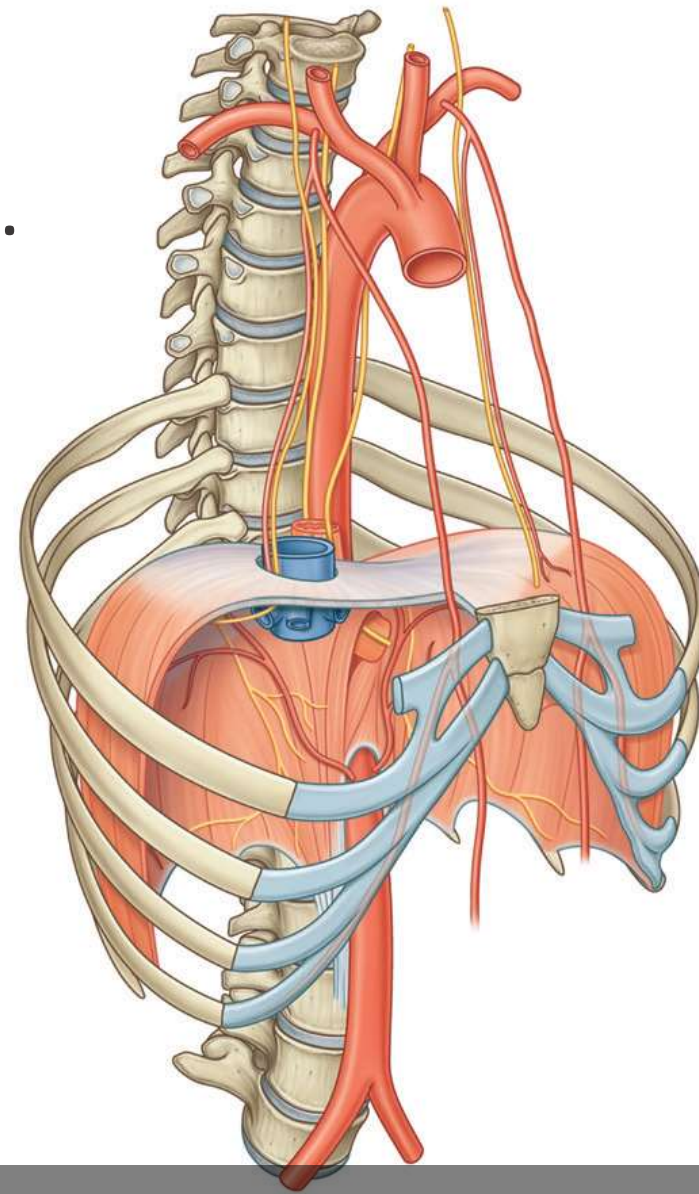
♦ Sin. - pars muscularis



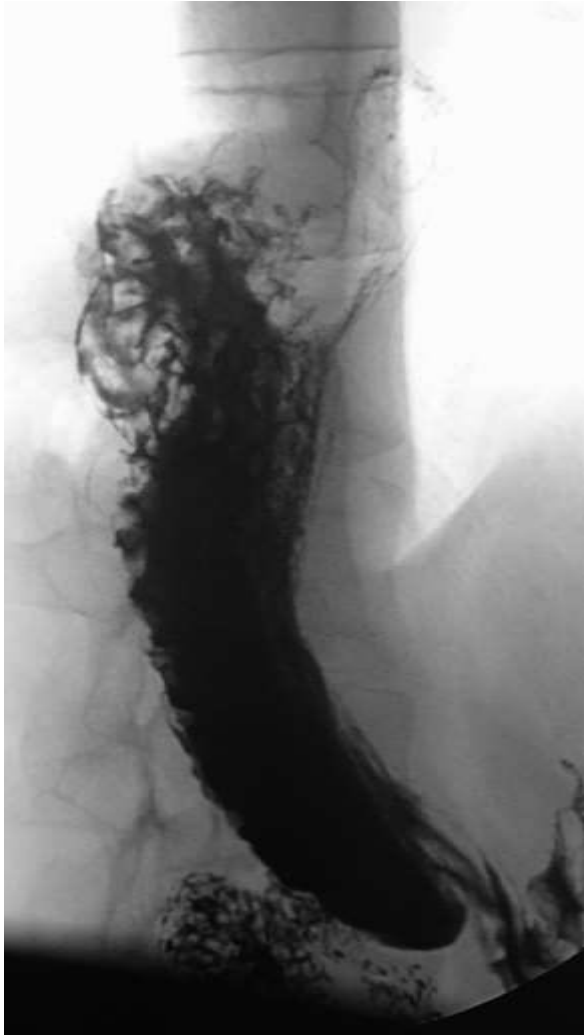
INNERVATION



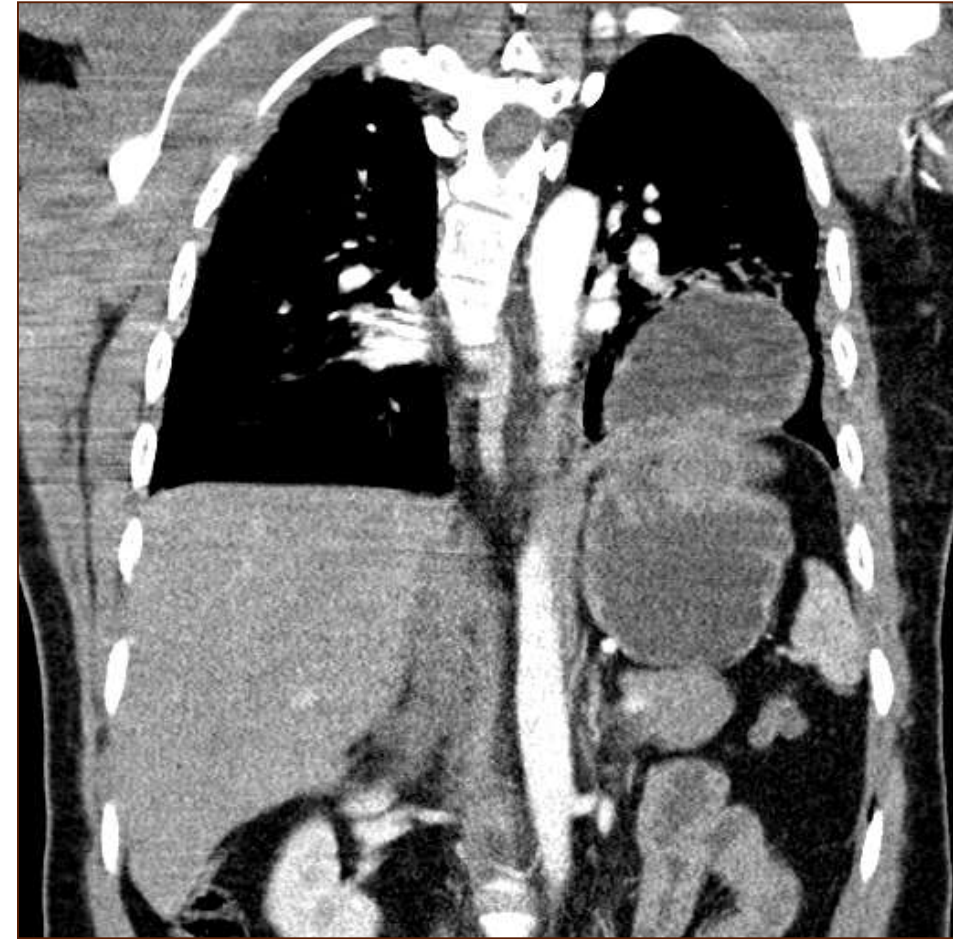
- ♦ **A. phrenica inferior dx. et sin.**
- ♦ *Superior abdominal aorta*
- ♦ **A. phrenica superior dx. et sin.**
- ♦ *Lower thoracic aorta*
- ♦ **A. thoracica interna dx. et sin.**
 - ♦ a. pericardiophrenica
- ♦ **Aa. intercostales 5 - 11**
- ♦ **A. subcostalis (pod 12.ž)**



VESSELS



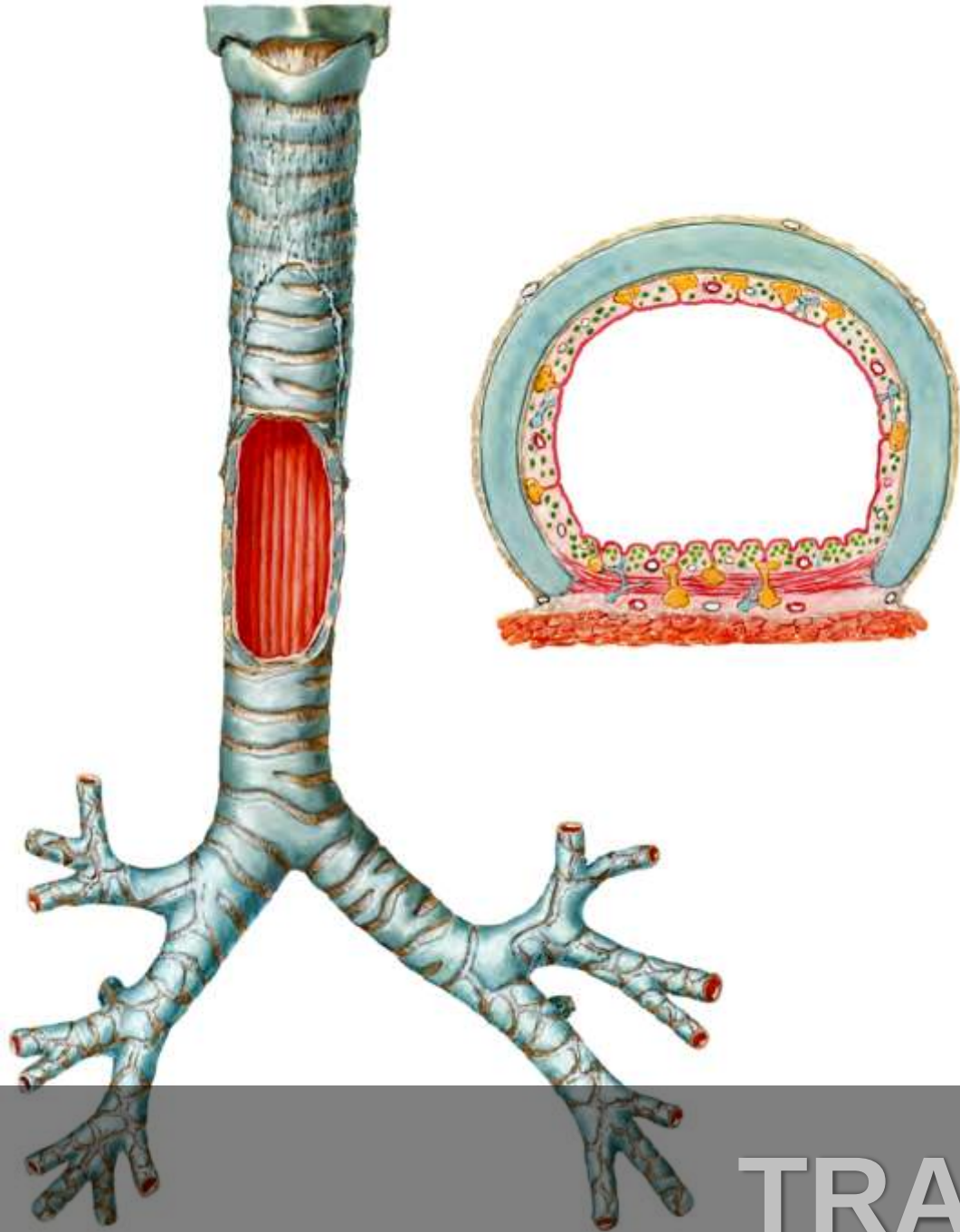
-
- **Hiatus oesophagealis**
 - hiatal hernia
 - stomach
- **Hernia Bochdaleki**
 - liver (dx), colon, spleen (sin)
- **Hernia Morgagni**
 - Colon transversum
- **Injury of diaphragm**
 - liver (dx), stomach (sin)



DIAPHRAGMATIC HERNIAS

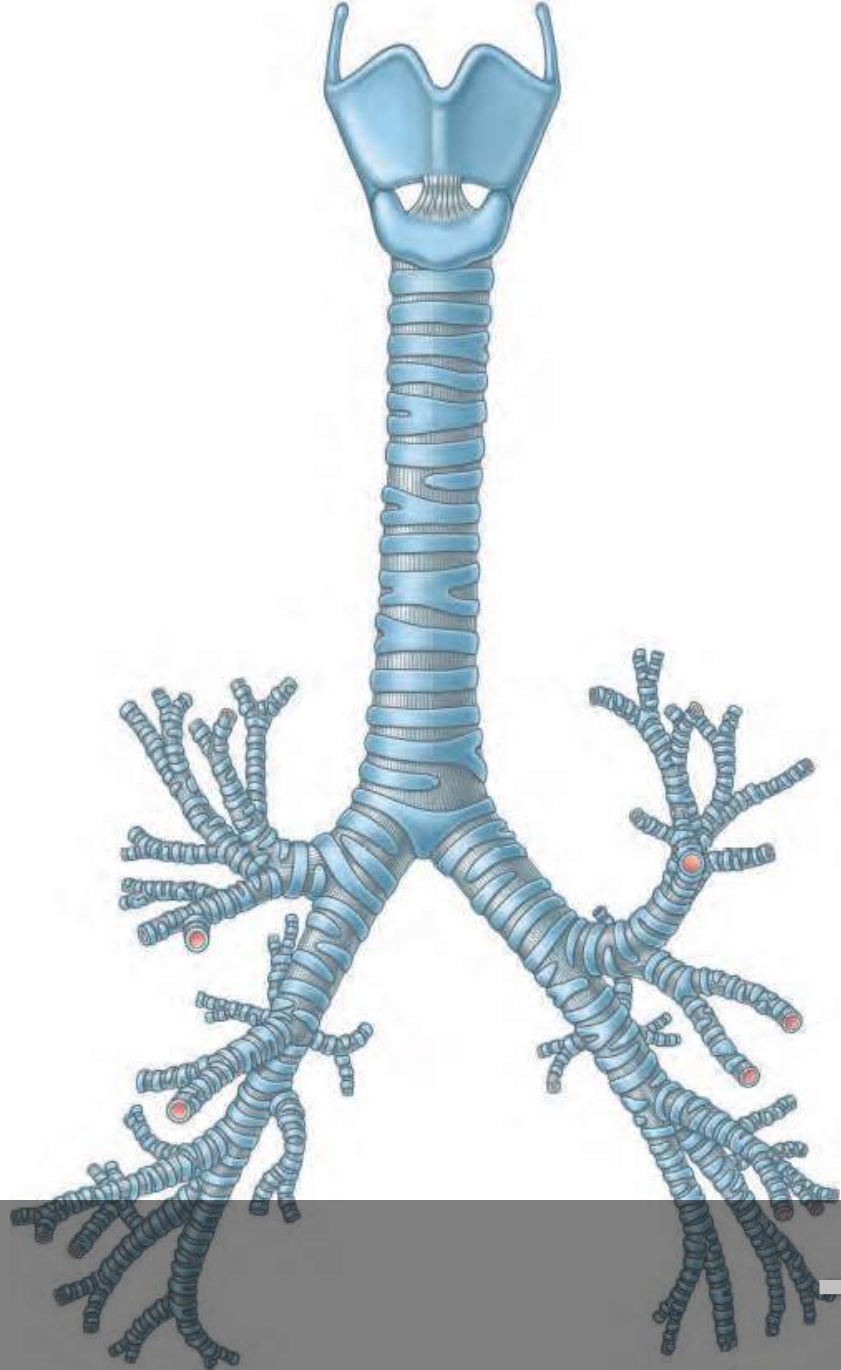
Thorax – trachea and bronchi

Prof. MUDr. Jiří Ferda, Ph.D.



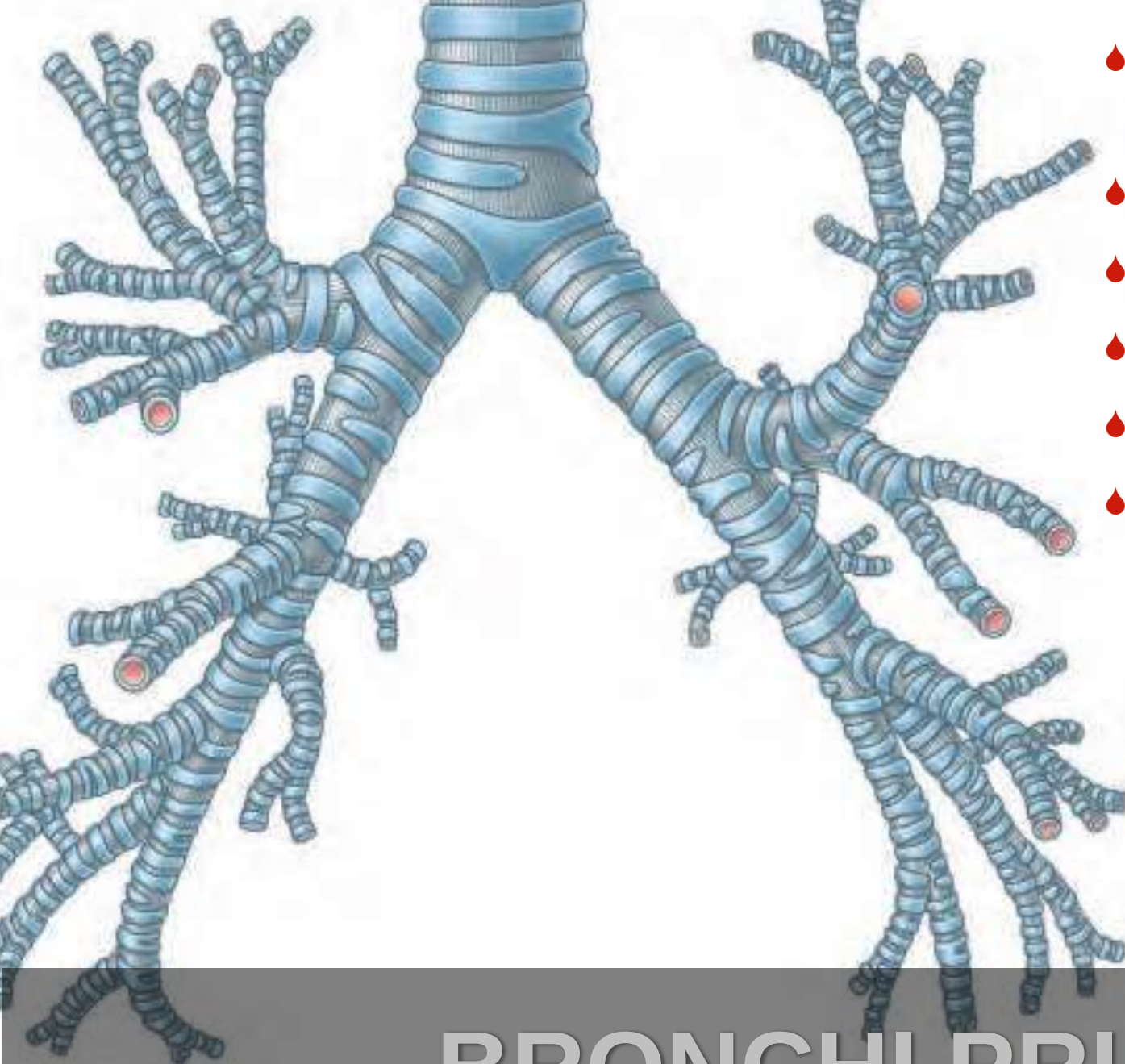
- ◆ Continuattion to larynx
- ◆ extent C6 - Th4
- ◆ Lig. cricotracheale
- ◆ Paries membranaceus
- ◆ Musculus trachealis
- ◆ Cartilago tracheale
- ◆ Ligamentum anulare
- ◆ Fascia praetrachealis - adventicia
- ◆ Plicae verticales
- ◆ Fibrae elasticae
- ◆ Glandulae tracheales

TRACHEA



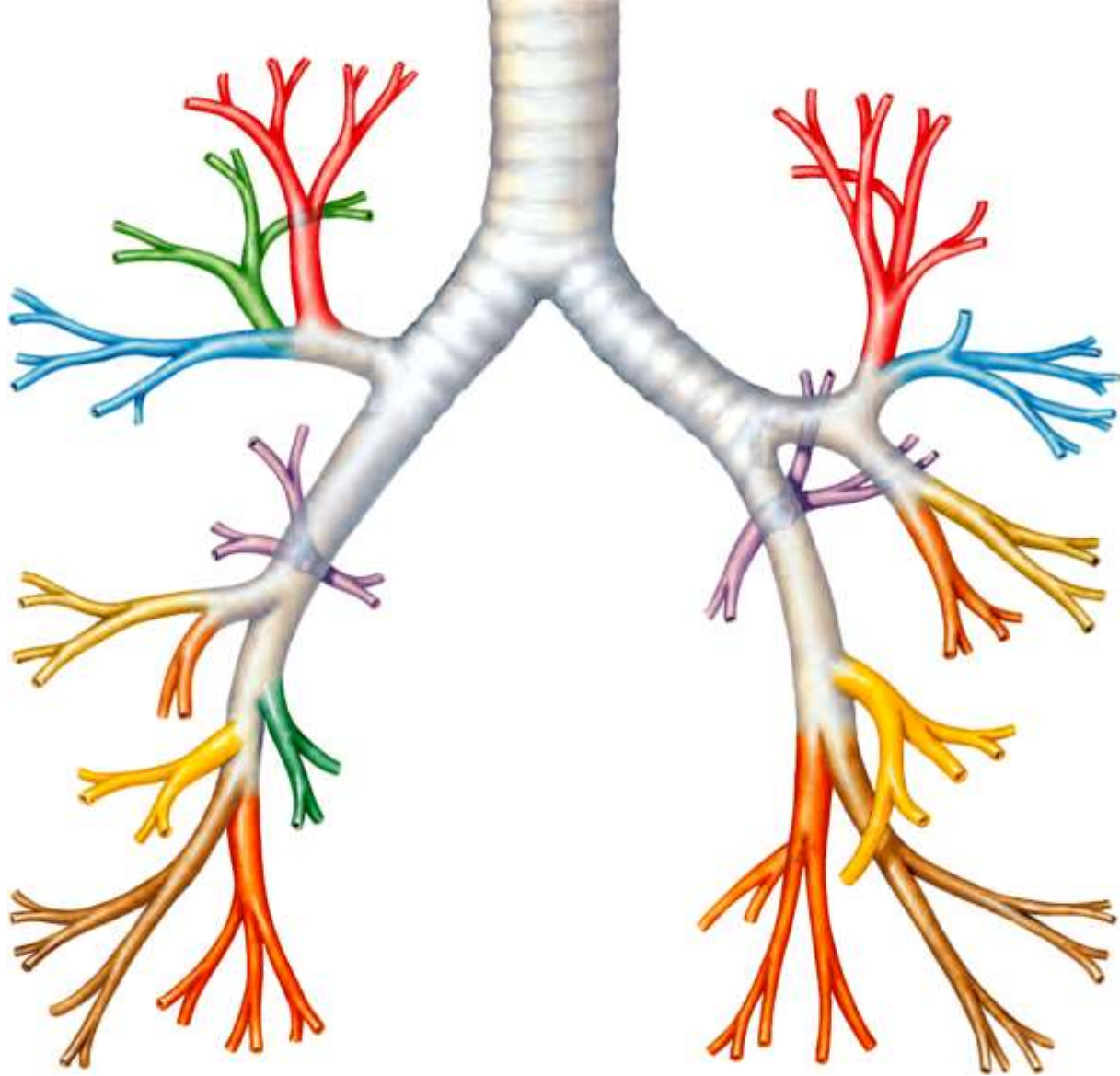
- ♦ Bifurcatio tracheae - Th4
- ♦ Carina tracheae
- ♦ Větví se na bronchus dexter a sinister
- ♦ Carina tracheae
- ♦ Angle of bifurcation 70 - 90 gr.
- ♦ Bronchus dx. 30 gr. from vertical
- ♦ Bronchus sin. 60 gr. from vertical

TRACHEA



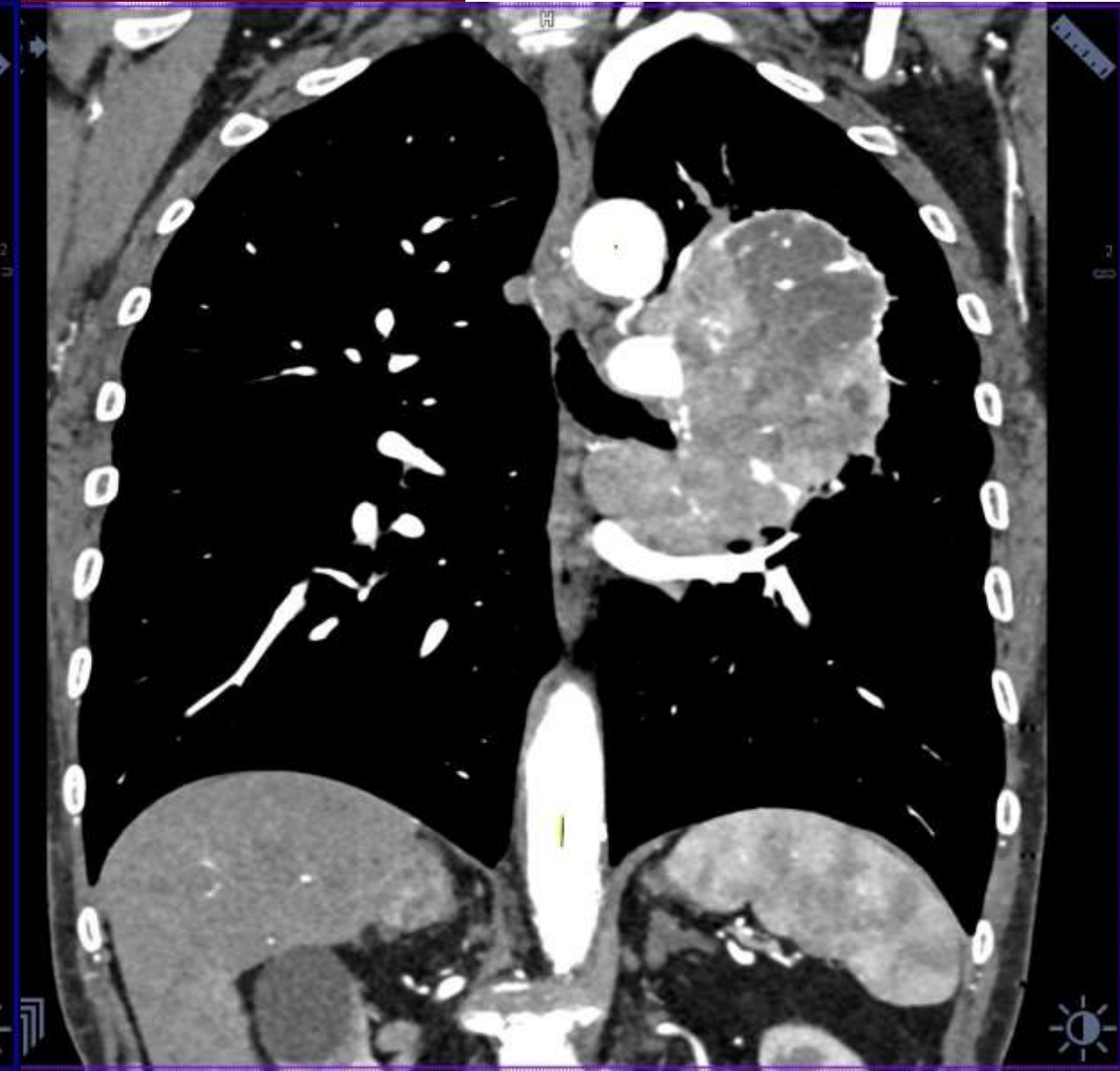
- ♦ **Bronchus principalis**
 - ♦ Laterodorsocaudal course
- ♦ **Dexter**
- ♦ Shorter, thicker, straight
- ♦ **Sinister**
- ♦ Longer thinner, S-shaped
- ♦

BRONCHI PRINCIPALES

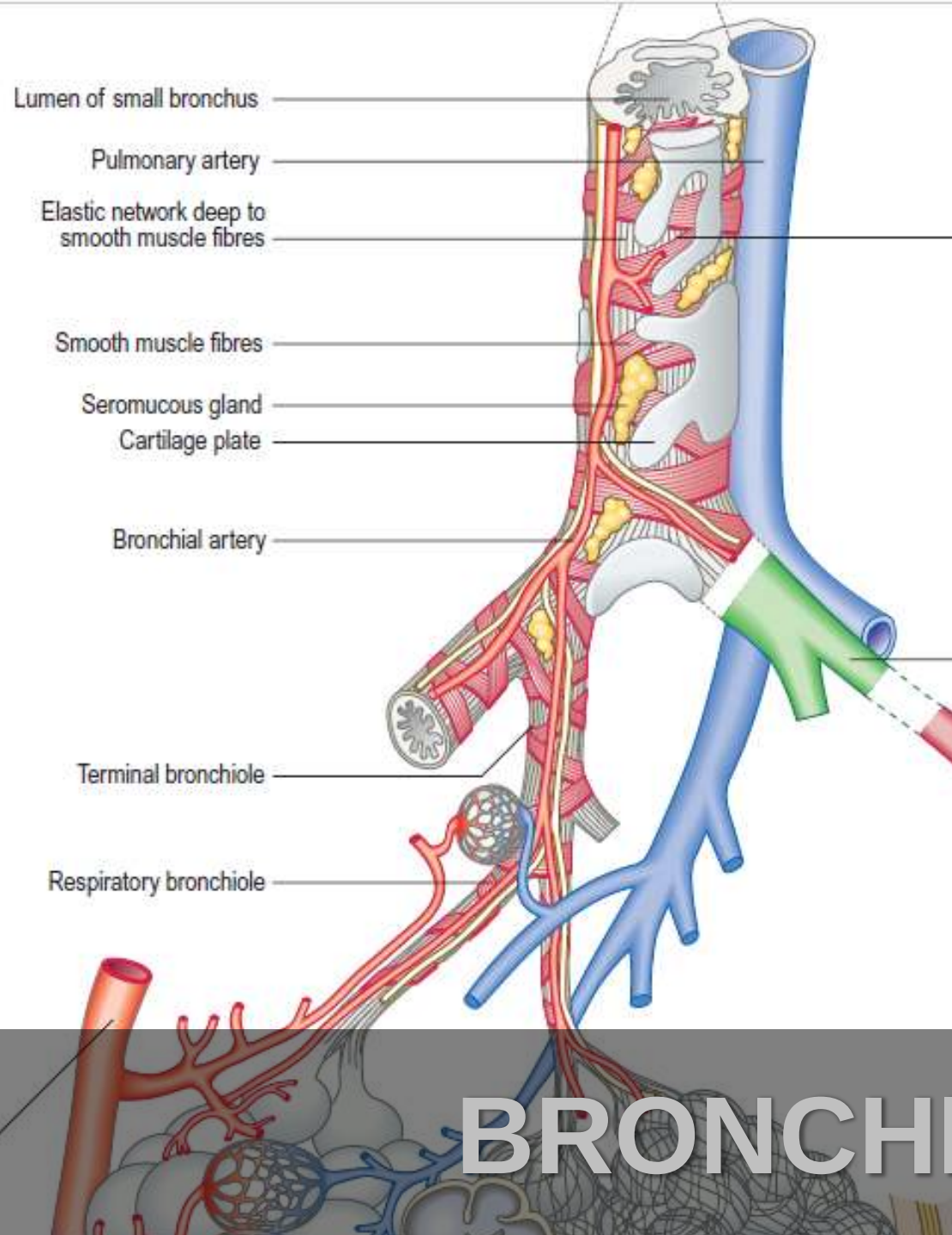


- ♦ Bronchi lobares
- ♦ Bronchus intermedius (dx)
- ♦ Bronchi segmentales
- ♦ Bronchi subsegmentales

BRONCHI



LUNG CARCINOMA



♦ mucosa

- ♦ Cylindric ciliary epithelium
- ♦ glands
- ♦ Lymphatic follicles

♦ muscularis

- ♦ Regulation of lumen
- ♦ Smooth muscles
- ♦ Parasympaticus - constriction
- ♦ Sympaticus - dilatation

♦ Fibrocartiliginous layer

- ♦ Larger bronchi – cartilaginous arches
- ♦ More than 1 mm – plates in division
- ♦ Less than 1 mm – no cartilage

BRONCHIAL WALL

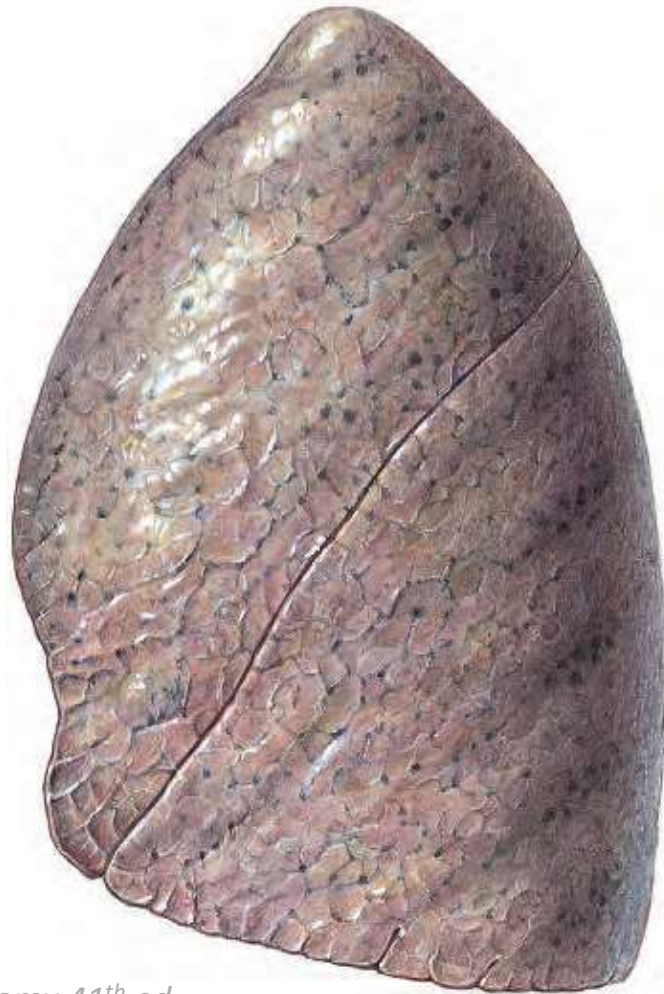


- ♦ **Bronchiolus terminalis**
- ♦ **Bronchiolus respiratorius**
 - ♦ Equipped with alveoli
- ♦ **Ductus alveolaris**
 - ♦ Last with muscles
- ♦ **Atrium**
- ♦ **Sacculi alveolares**
- ♦ **Alveoli (10 pro sacculum)**
- ♦ *Flat single.layered epithelium*
- ♦ *Rete capillare*
- ♦ *Single layer of endothelium*

TERMINÁLNÍ VĚTVENÍ BRONCHŮ

Thorax – lungs and pulmonary circulation

Prof. MUDr. Jiří Ferda, Ph.D.



Gray's Anatomy 41th ed.

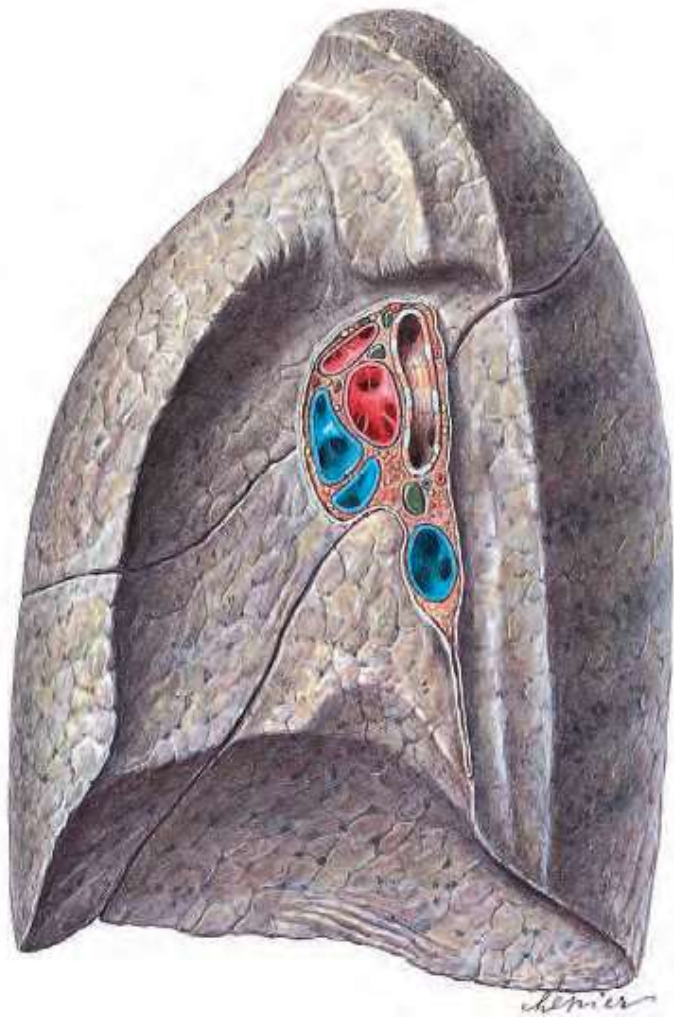
♦ Pulmo dexter

- ♦ Lobus superior
- ♦ Lobus medius
- ♦ Lobus inferior
- ♦ *Fissura horizontalis*
- ♦ *Fissura obliqua*

♦ Pulmo sinister

- ♦ Lobus superior
 - ♦ Lingula
- ♦ Lobus inferior
- ♦ *Fissura obliqua*

PULMONES



- ♦ **Apex pulmonis**
- ♦ **Facies medialis**
- ♦ **Hilus pulmonis**
- ♦ **Facies costalis**
- ♦ **Facies diaphragmatica**
- ♦ **Basis pulmonis**

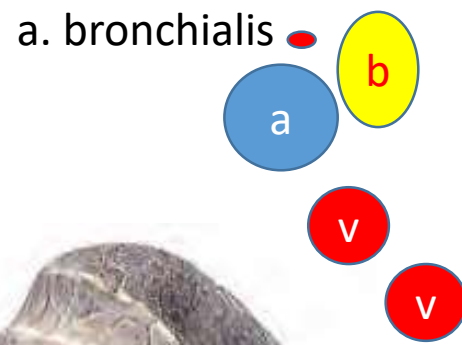


PULMONES

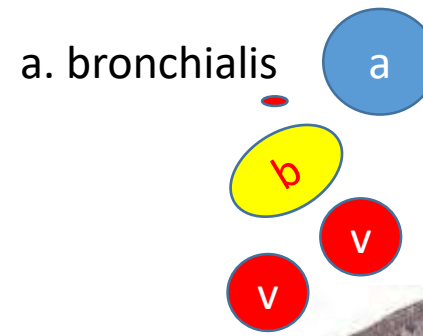


- RTG
- **fields**
- upper
- middle
- lower
- **Lobar projections**
- angles
- costophrenic
- cardiophrenic
- Lung hilum
- Trachea

X-RAY LUNG ANATOMY



DX

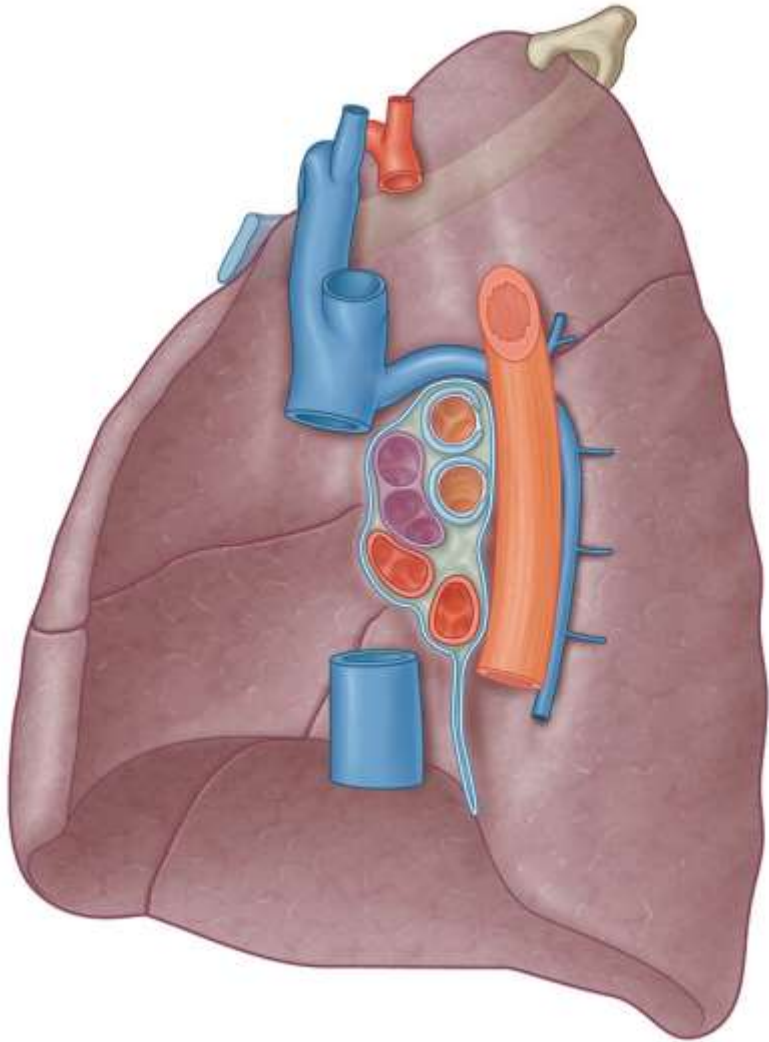


SIN

- 🔴 **Bronchus**
- 🔴 **Arteria pulmonalis**
- 🔴 **Venae pulmonales**
- 🔴 **Arteria bronchialis**

Gray's Anatomy 41th ed.

HILUS PULMONIS



♦ lobes/segments

♦ Lobus superior

- ♦ Apicalis S1
- ♦ Posterior S2
- ♦ Anterior S3

♦ Lobus medius

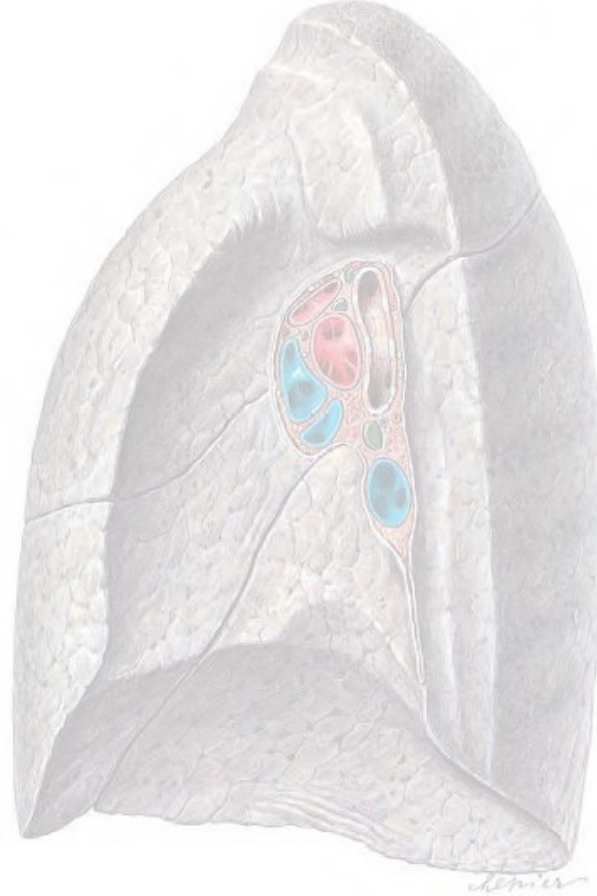
- ♦ Lateralis S4
- ♦ Medialis S5

♦ Lobus inferior

- ♦ Basalis apicalis S6
- ♦ Basalis medialis S7
- ♦ Basalis anterior S8
- ♦ Basalis lateralis S9
- ♦ Basalis posterior S10



PULMO DEXTER



♦ lobes/segments

♦ Lobus superior

- ♦ Apicalis S1
- ♦ Posterior S2
- ♦ Anterior S3

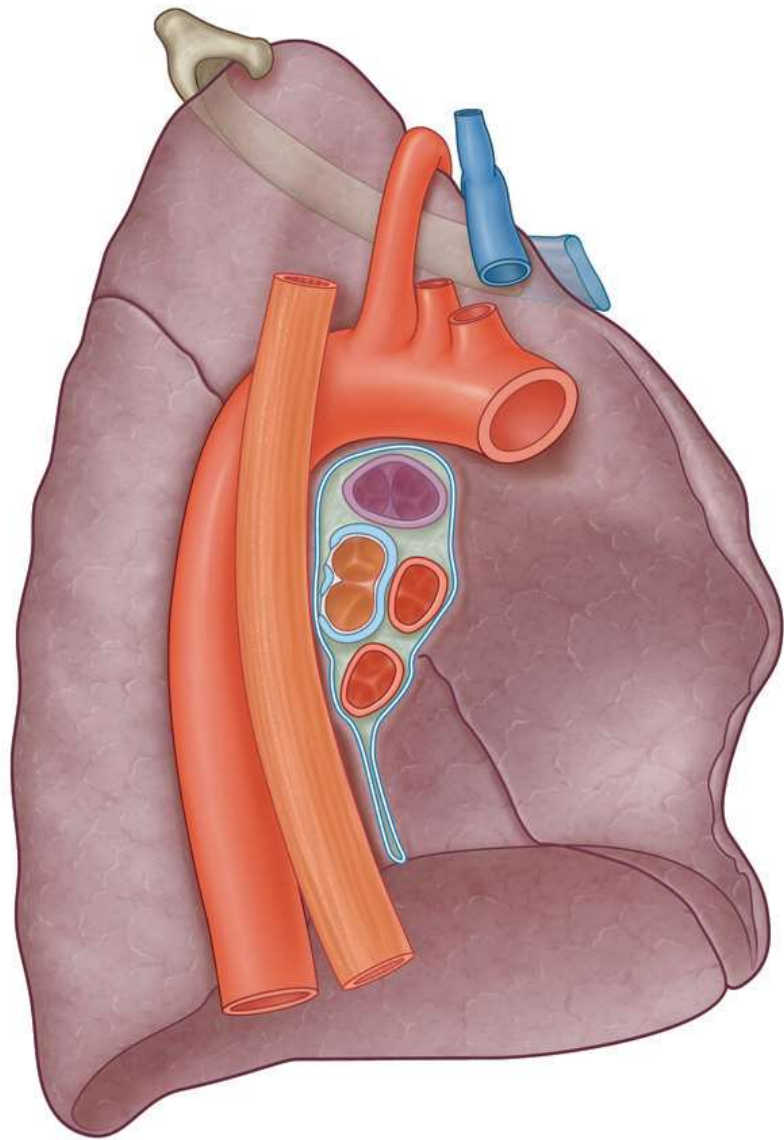
♦ Lobus medius

- ♦ Lateralis S4
- ♦ Medialis S5

♦ Lobus inferior

- ♦ Basalis apicalis S6
- ♦ Basalis medialis S7
- ♦ Basalis anterior S8
- ♦ Basalis lateralis S9
- ♦ Basalis posterior S10

PULMO DEXTER



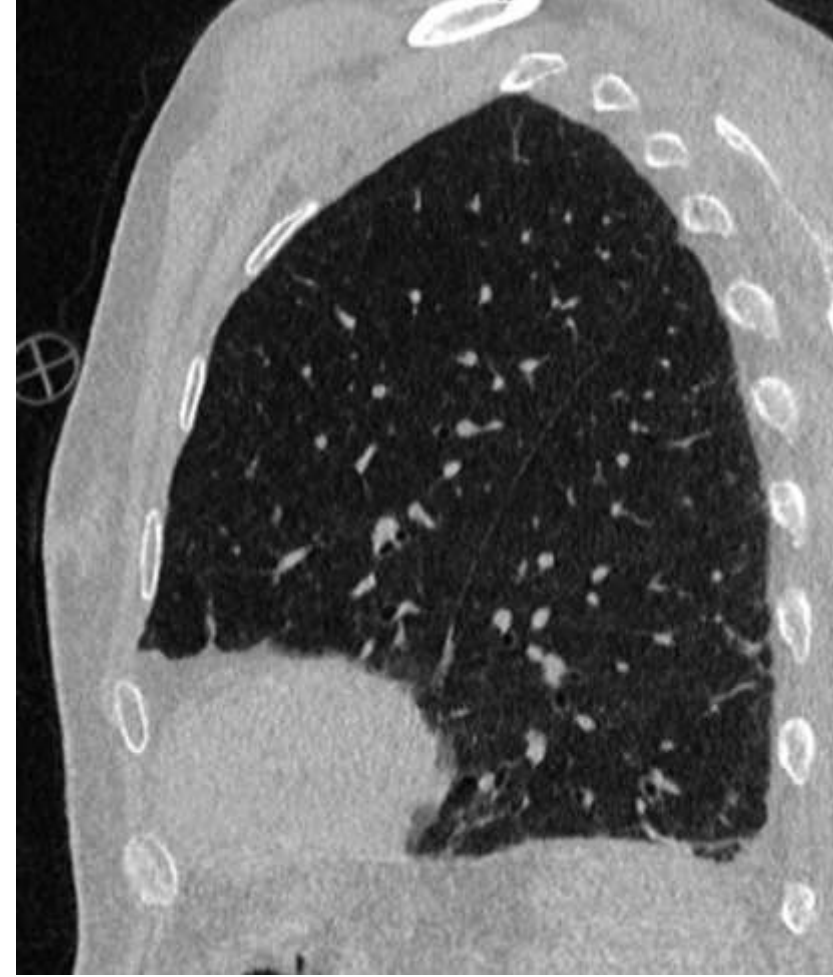
♦ lobes/segments

♦ Lobus superior

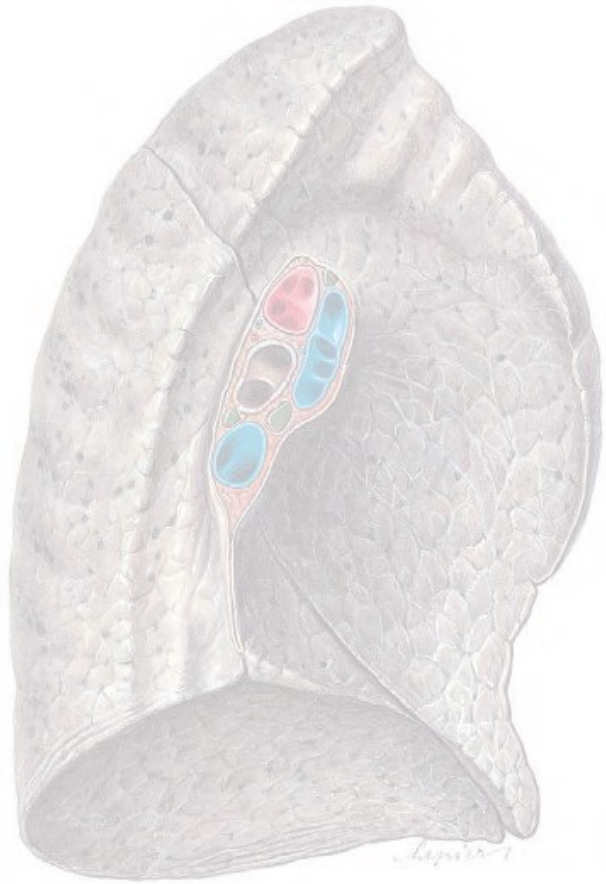
- ♦ Apicoposterior S1+2
- ♦ Anterior S3
- ♦ Lingularis superior S4
- ♦ Lingularis inferior S5

♦ Lobus inferior

- ♦ Basalis apicalis S6
- ♦ (*Basalis medialis* S7)
- ♦ Basalis anterior S7+8
- ♦ Basalis lateralis S9
- ♦ Basalis posterior S10



PULMO SINISTER



♦ lobes/segments

♦ Lobus superior

- ♦ Apicoposterior S1+2
- ♦ Anterior S3
- ♦ Lingularis superior S4
- ♦ Lingularis inferior S5

♦ Lobus inferior

- ♦ Basalis apicalis S6
- ♦ (*Basalis medialis* S7)
- ♦ Basalis anterior S7+8
- ♦ Basalis lateralis S9
- ♦ Basalis posterior S10

PULMO SINISTER

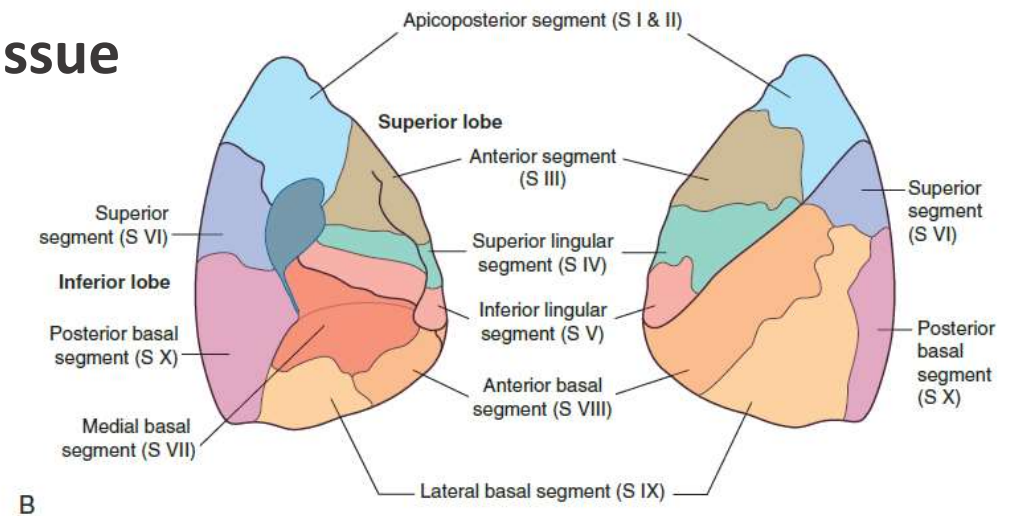
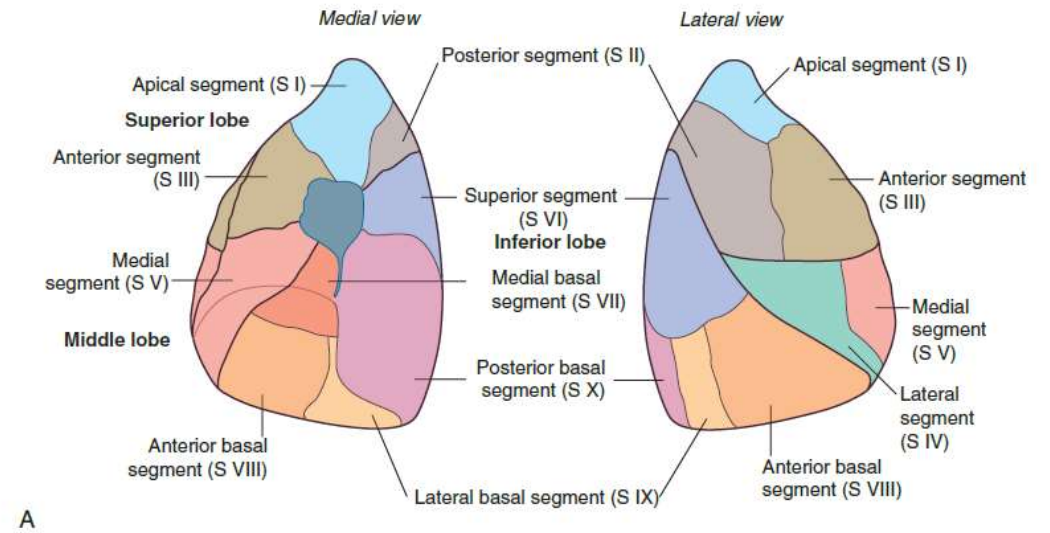
🔥 conic

🔥 Central structure

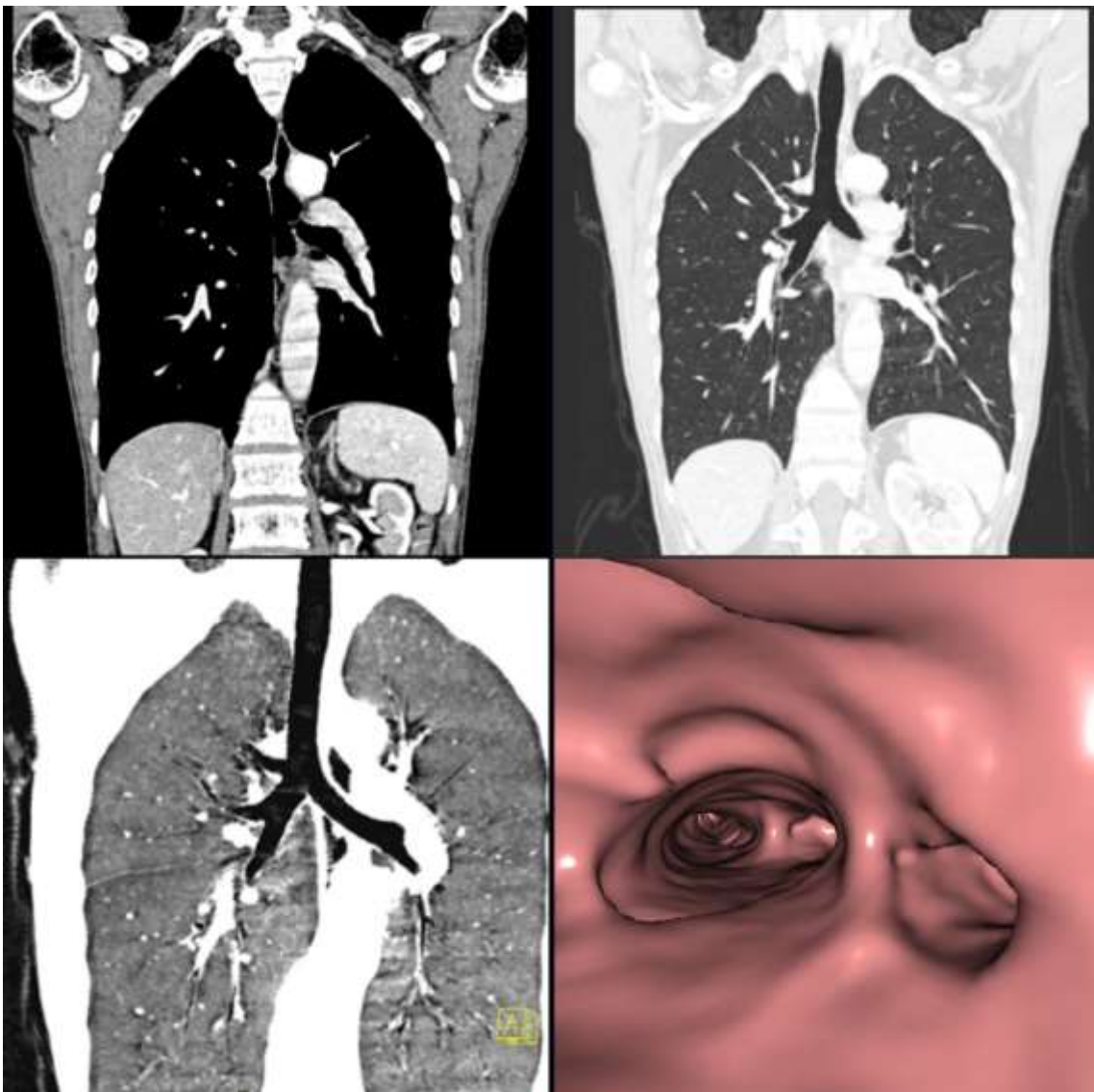
- 🔥 Bronchus
- 🔥 Branch of a. pulmonalis
- 🔥 Branch of a. bronchialis
- 🔥 Central lymphatics

🔥 periphery – septum from connective tissue

- 🔥 Rami venae pulmonalis
- 🔥 Lymphatic - peripheral



SEGMENTUM PULMONIS



♦ Tracheal bronchus

- ♦ In some mammals obvious (*Sus domestica*)

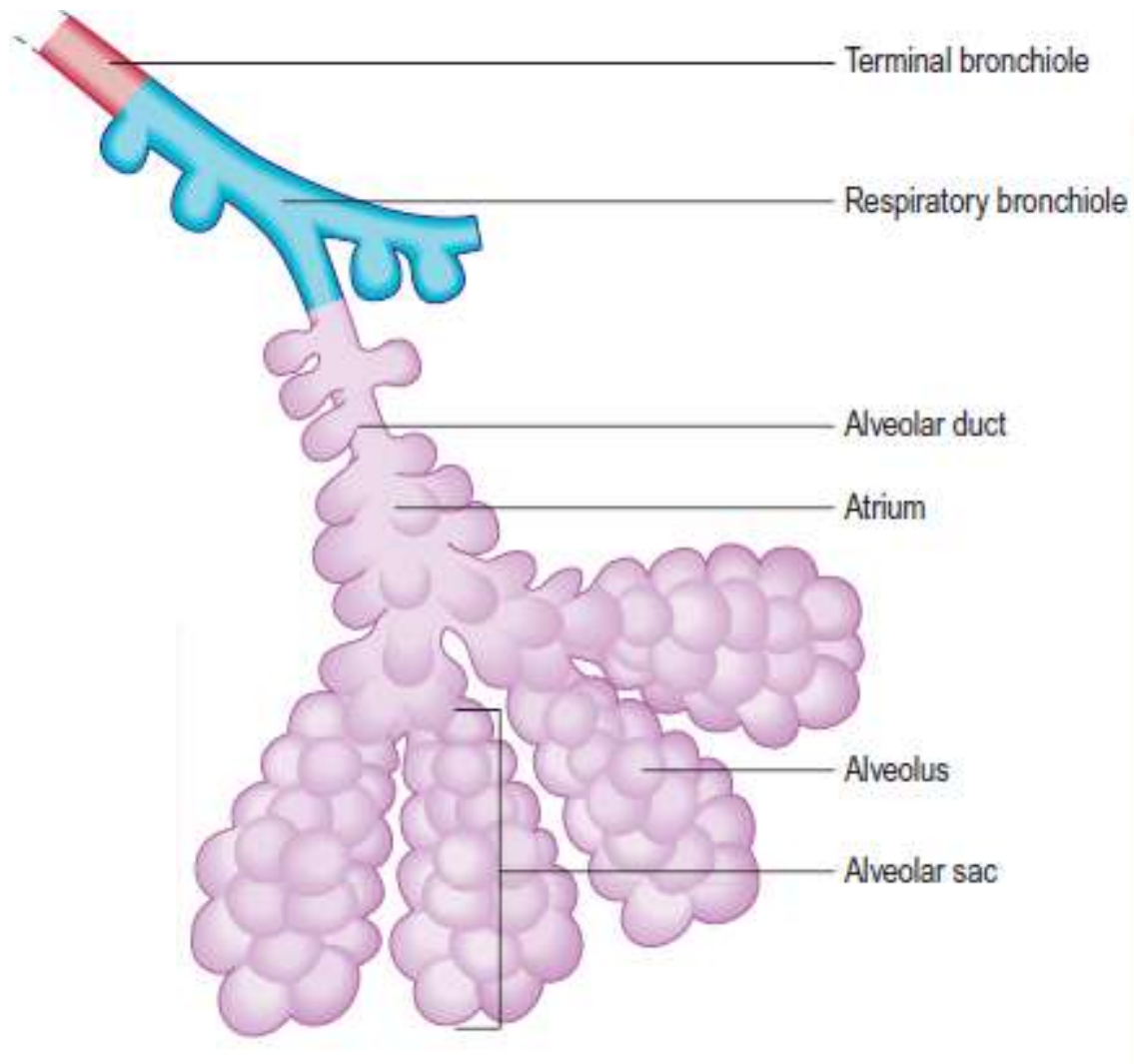
♦ Accessorial lobes

- ♦ Lobus venae azygos
- ♦ Lobus apicalis (S6)
- ♦ Lobus cardiacus (S7)
- ♦ Lobus medius sinister (S4,5)

♦ sequestration

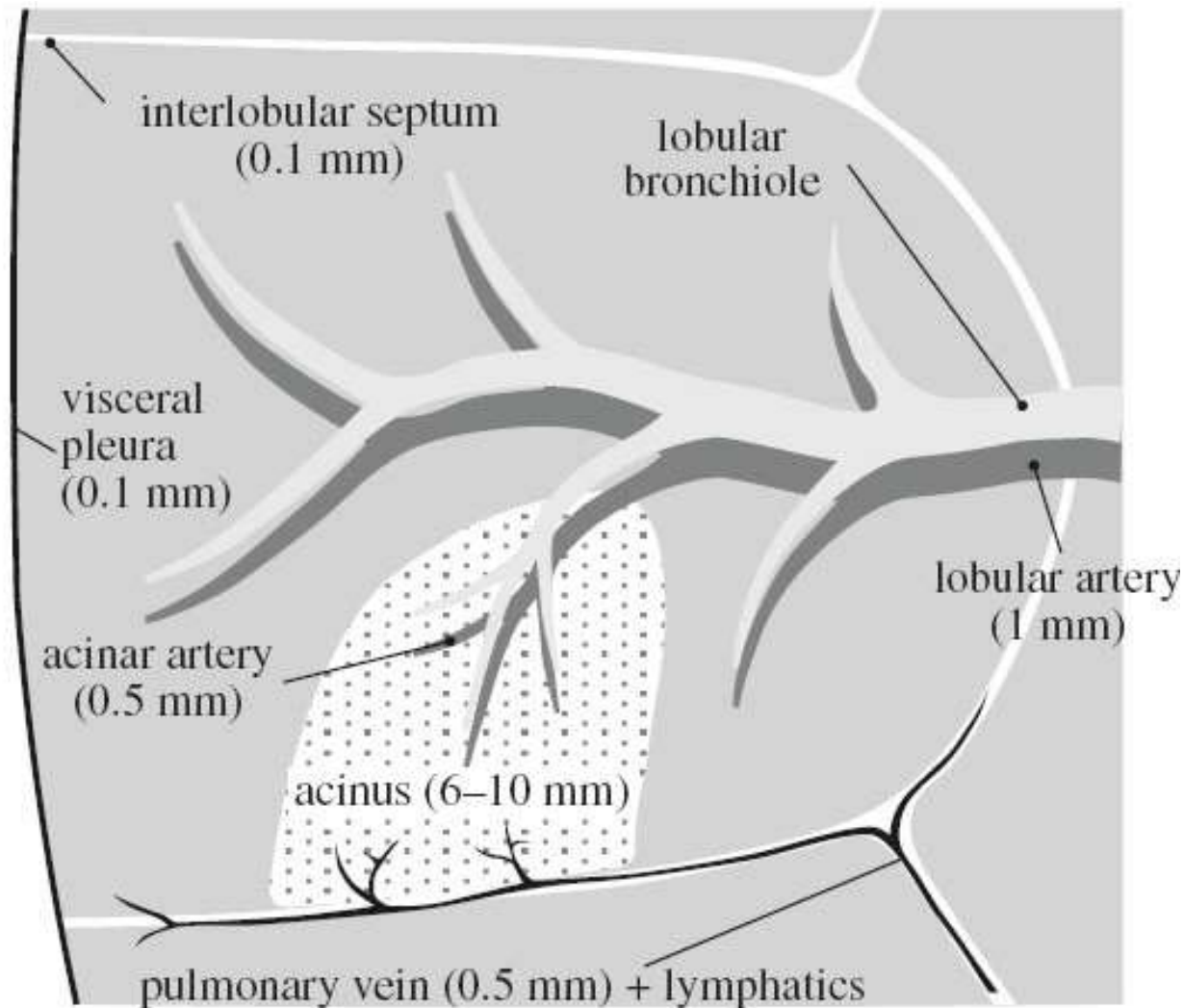
- ♦ No connection to pulmonary function circulation

VARIBILITY



- ♦ divisions 15 orders of bronchi
- ♦ Divisions of 5 orders of bronchioles
- ♦ „secondary lobulus“
 - ♦ 3 - 5 of terminal bronchioli
- ♦ Lobulus - „primary lobulus“
 - ♦ One terminal bronchiolus
- ♦ Acinus - 3 orders of respiratory bronchioli
 - ♦ Alveoli in wall
 - ♦ Ductuli alveolares
 - ♦ Last with muscles
 - ♦ Sacculi alveolares
 - ♦ Alveoli
 - ♦ Porus alveolares Kohni
 - ♦ Inter-alveolar connections

FUNCTIONAL ANATOMY OF LUNG



<https://radiologykey.com/and-function-of-lung/>

♦ „secondary lobulus“

- ♦ 3 - 5 terminal bronchioli

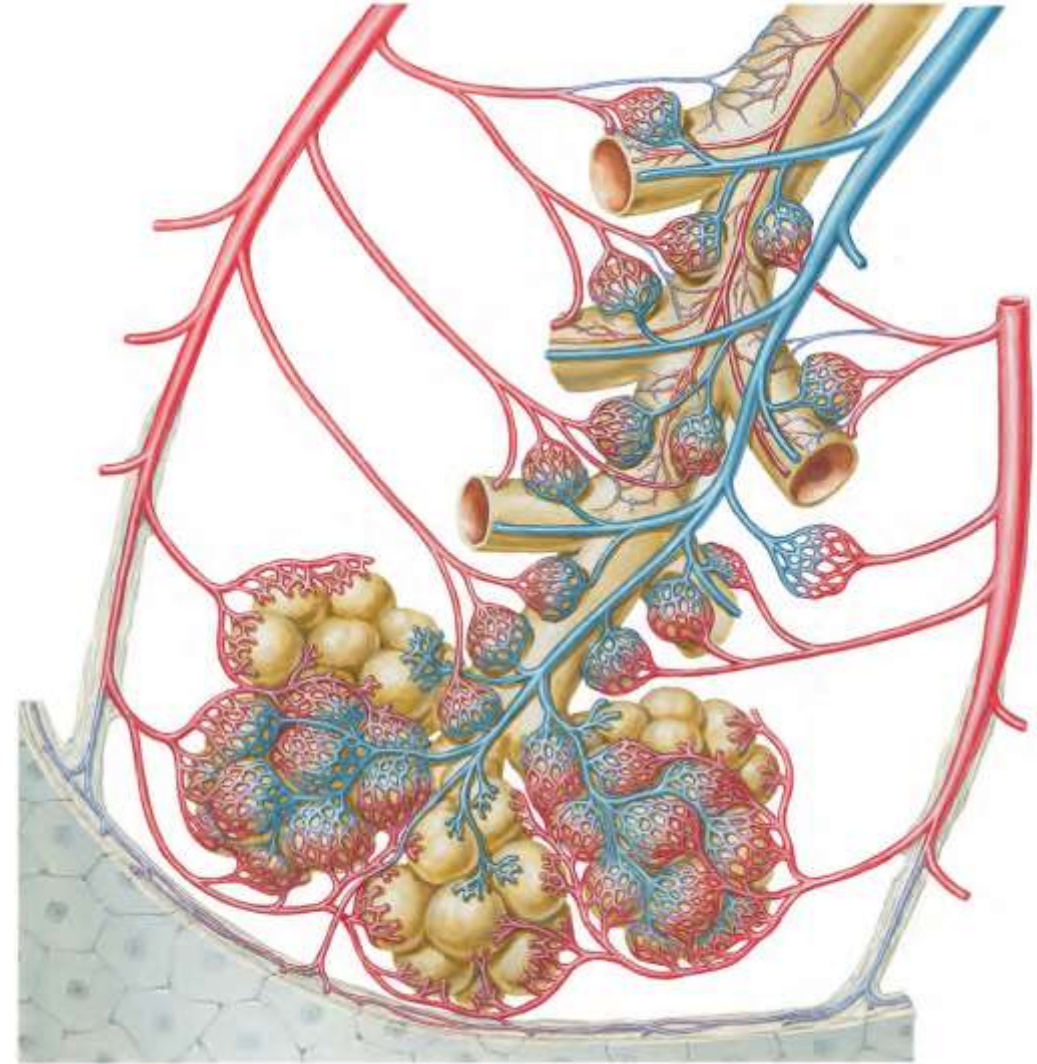
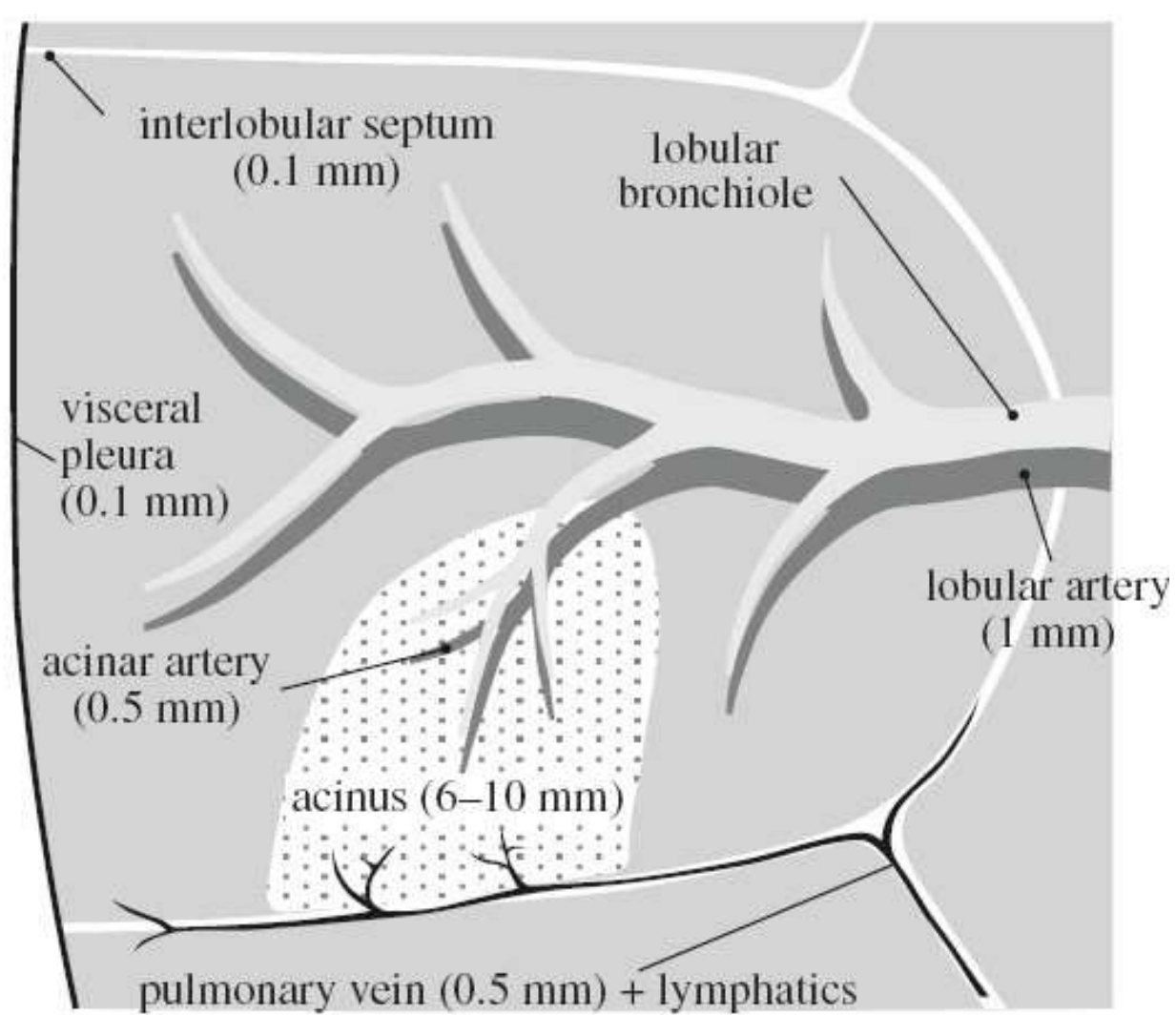
♦ Smallest to be displayed by imagin

- ♦ Its own margins
- ♦ size 1 - 2 cm
- ♦ RTG – axinous shadow- 1 cm

♦ Interlobular septum

- ♦ V. pulmonalis + lymphatics
- ♦ Intralobular septa between acini
- ♦ **Typical involvements**
- ♦ *Interstitial edema*
- ♦ *Alveolar edema*
- ♦ *Interstitial lung fibrosis*
- ♦ *Lung infections*

SECONDARY LOBULUS

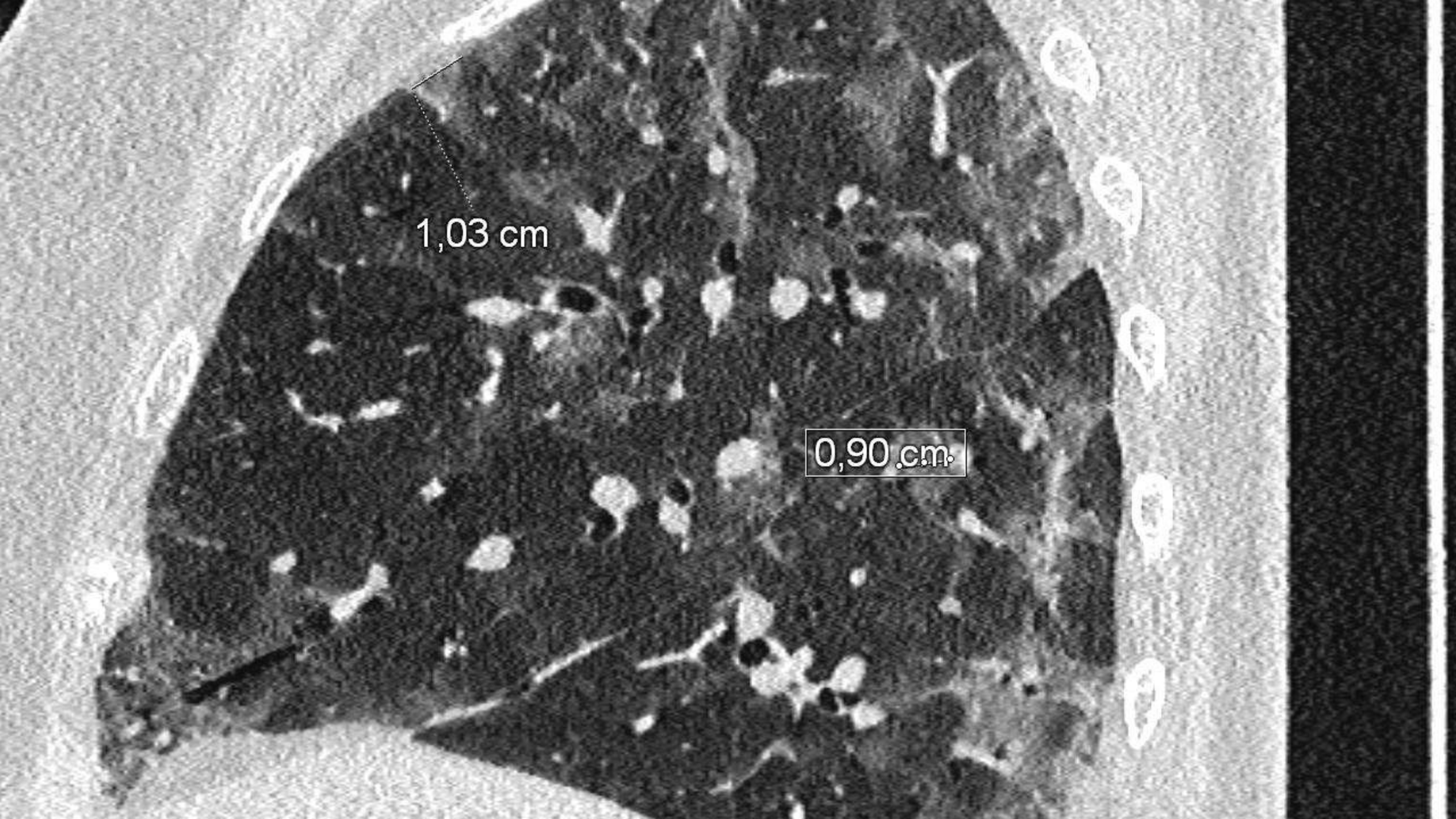


<https://radiologykey.com/and-function-of-lung/>

Netter Atlas of Anatomy

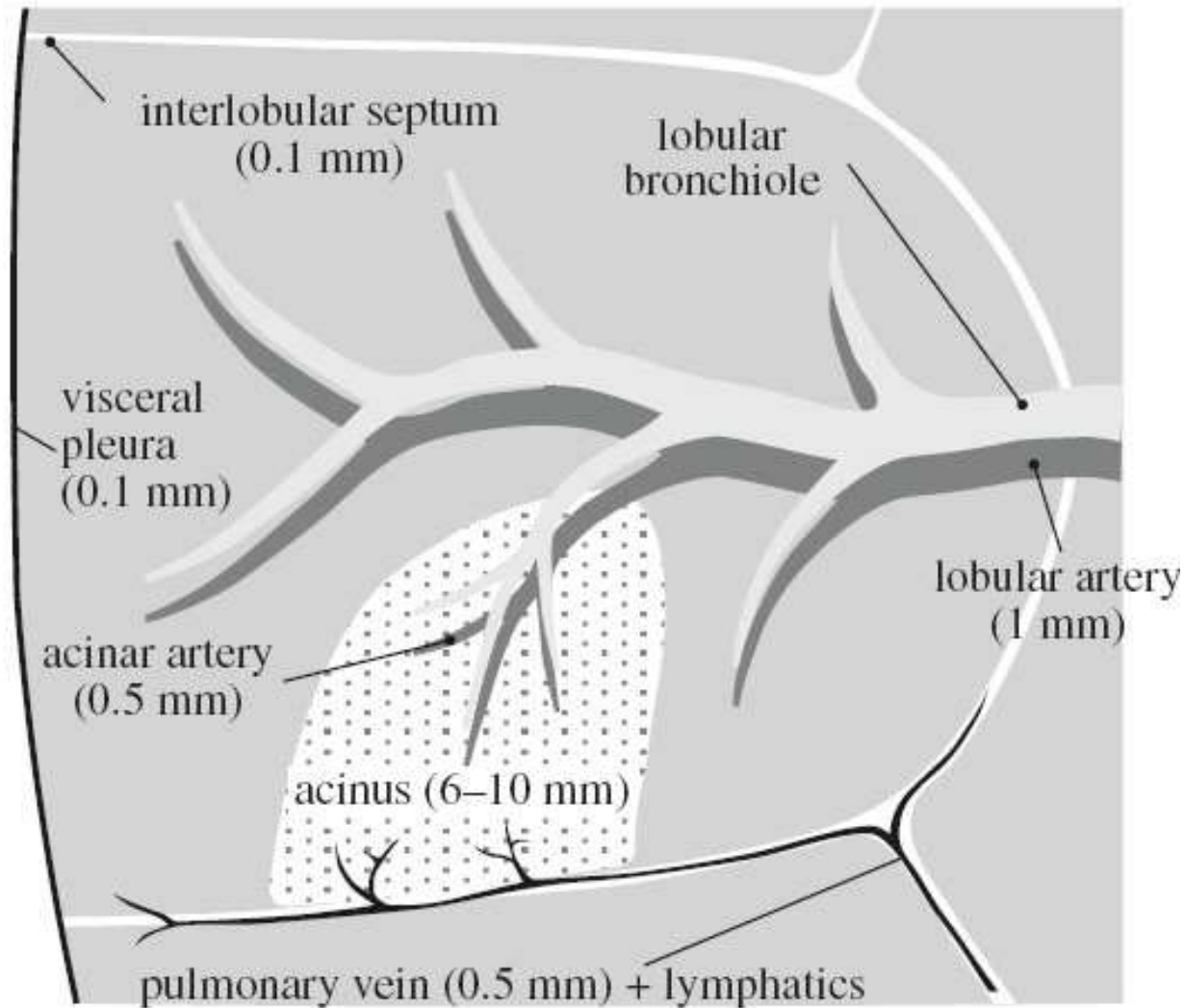
SECONDARY LOBULUS





1,03 cm

0,90 cm.

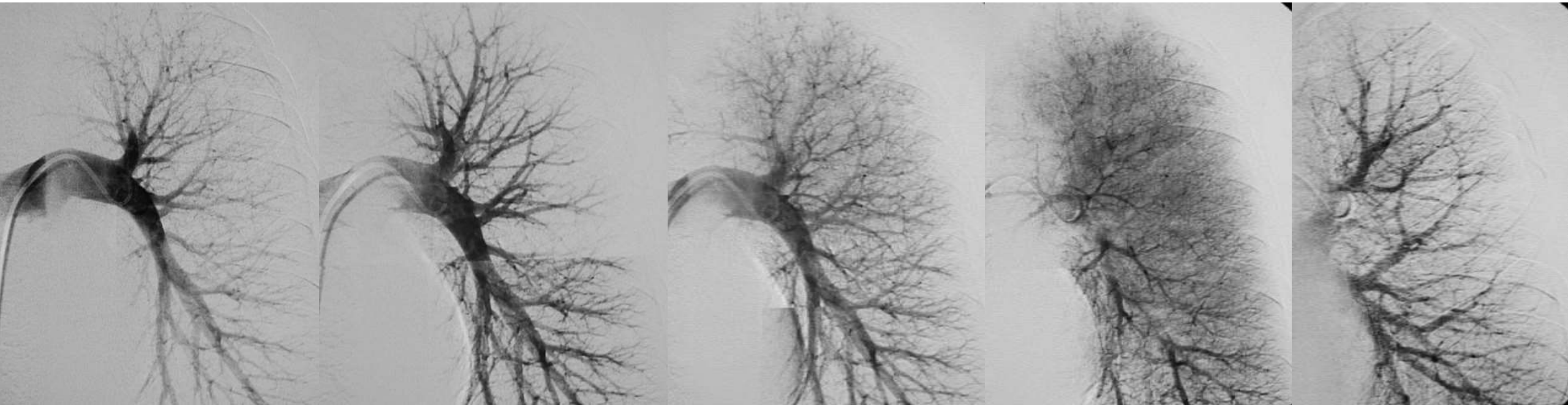


- ♦ *Alveolar epithelium*
- ♦ *Capillary endothelium*
- ♦ *Basement membrane*
- ♦ *Perivascular tissue*
- ♦ *Perilymphatic tissue*
- ♦ **central**
- ♦ **parenchymatous**
- ♦ **peripheral**
- ♦ **Interstitial lung disease**

<https://radiologykey.com/and-function-of-lung/>

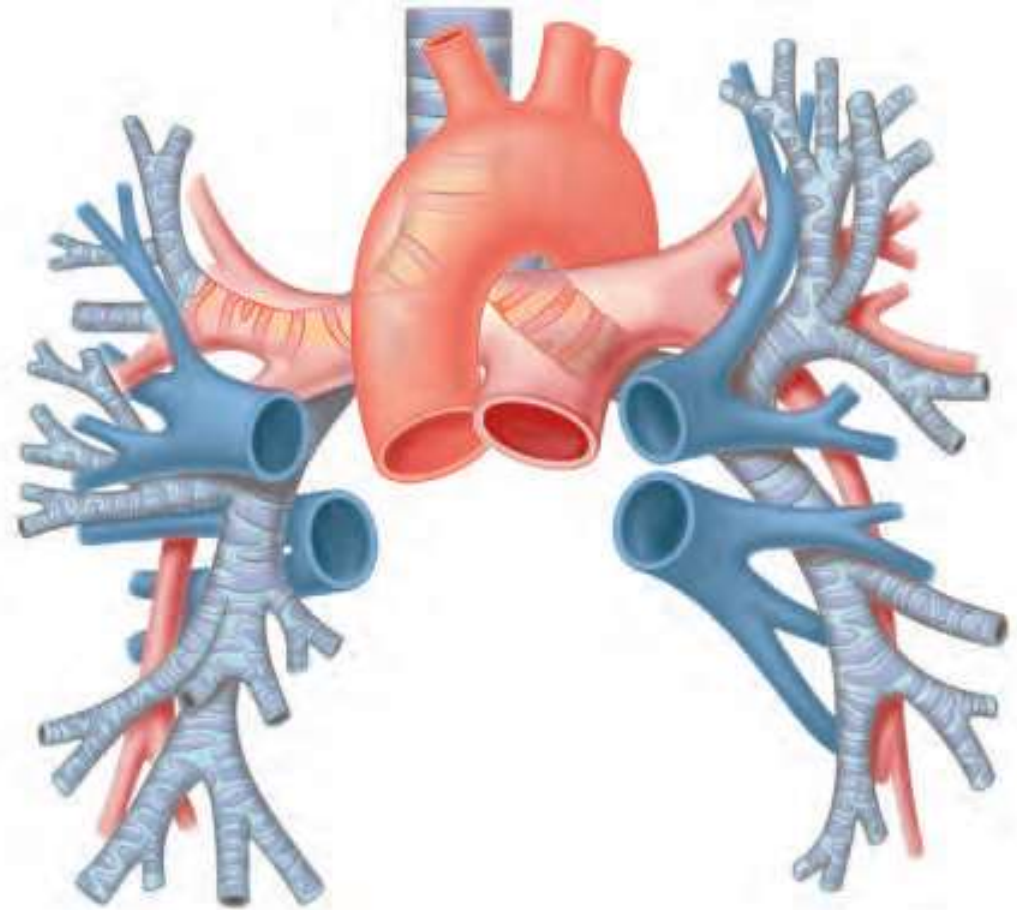
LUNG INTERSTICIUM

PULMONARY CIRCULATION

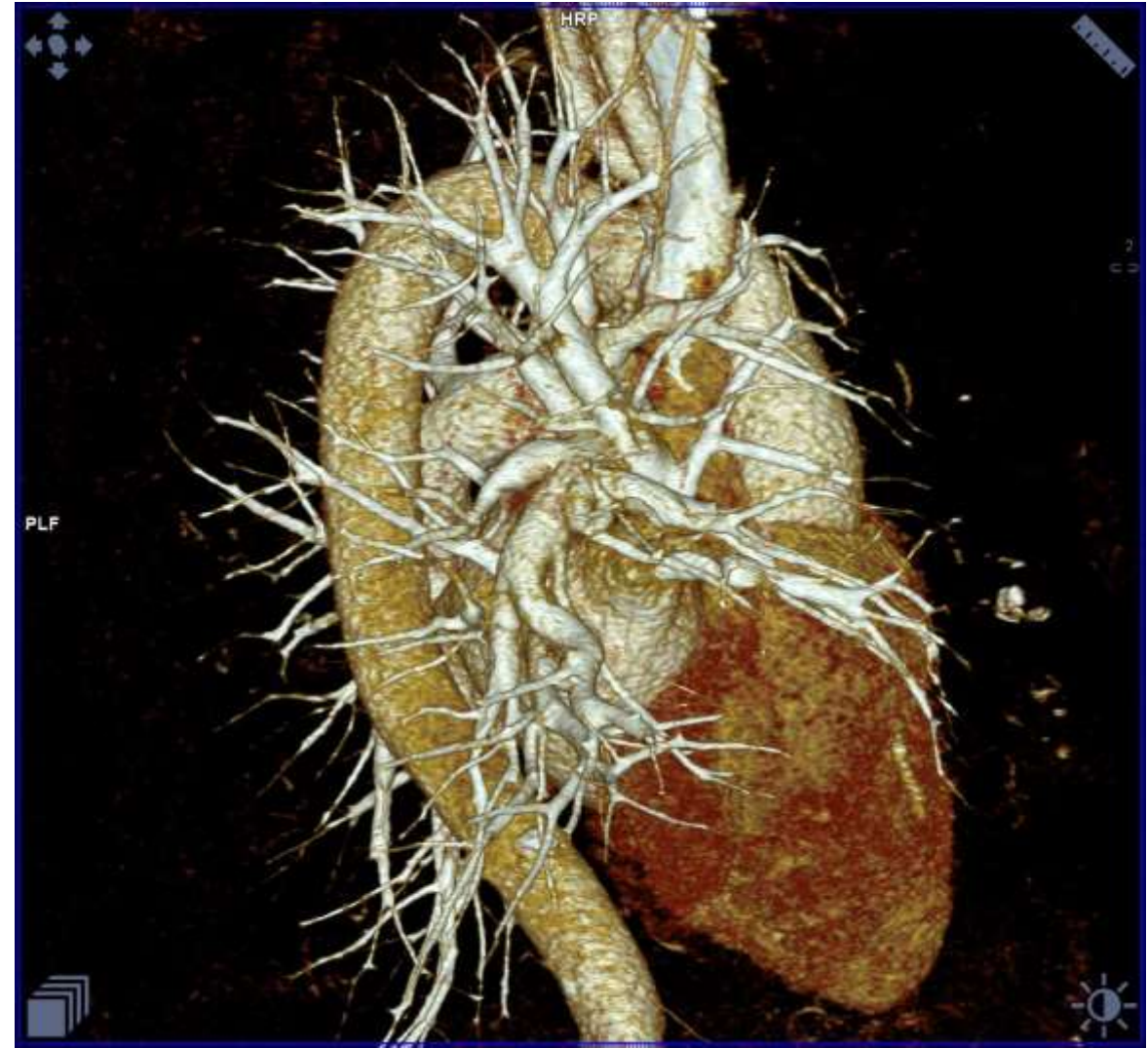
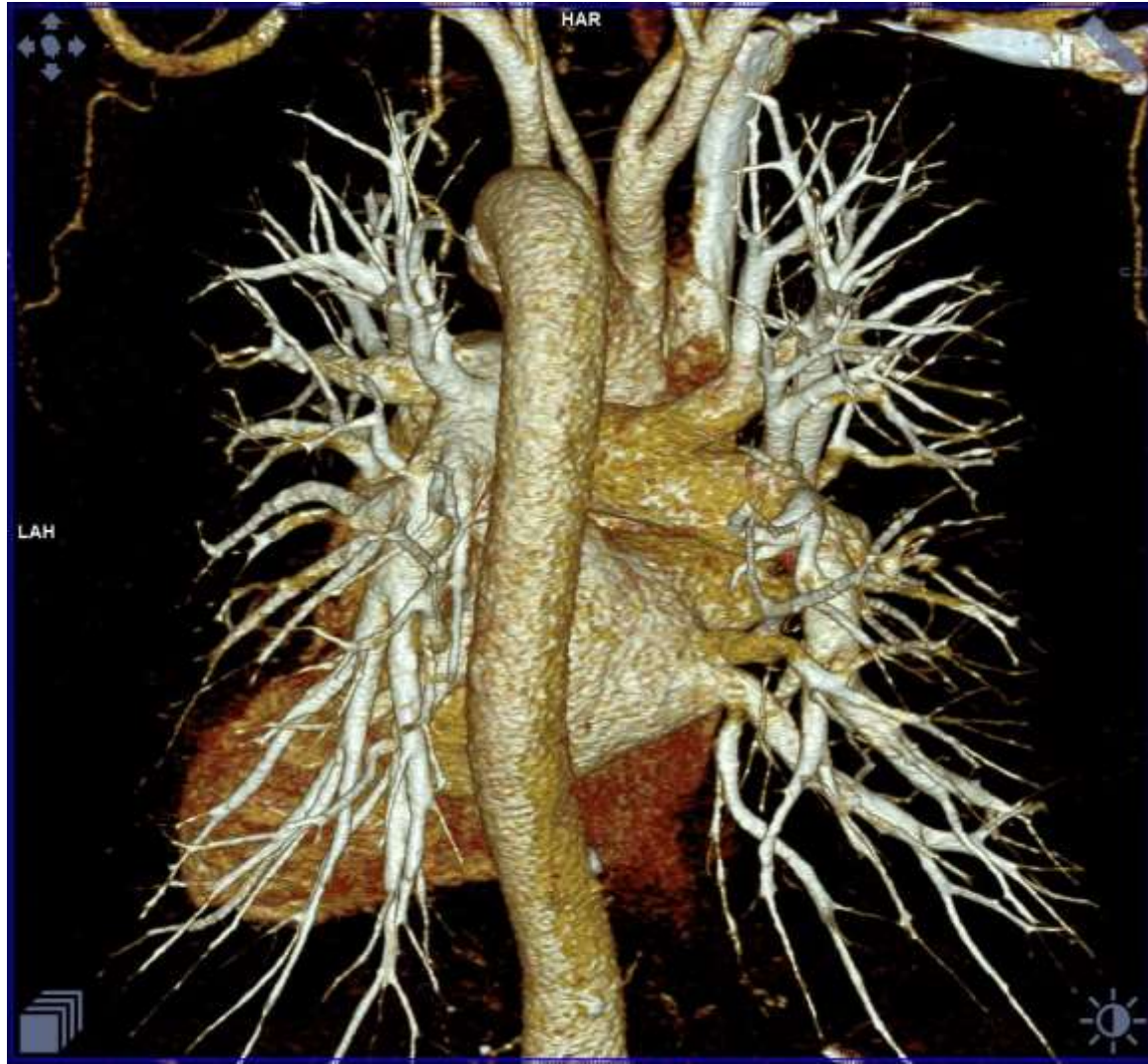


VASA PULMONUM

- ♦ **A. pulmonalis**
 - ♦ functional
 - ♦ Low level of oxygenation
- ♦ **Vv. Pulmonales**
 - ♦ functional
 - ♦ high level of oxygenation
- ♦ **aa. bronchiales**
 - ♦ Odstupy - aorta, intercostal arteries
 - ♦ Nutritive
 - ♦ Hypertrophic in chronic diseases



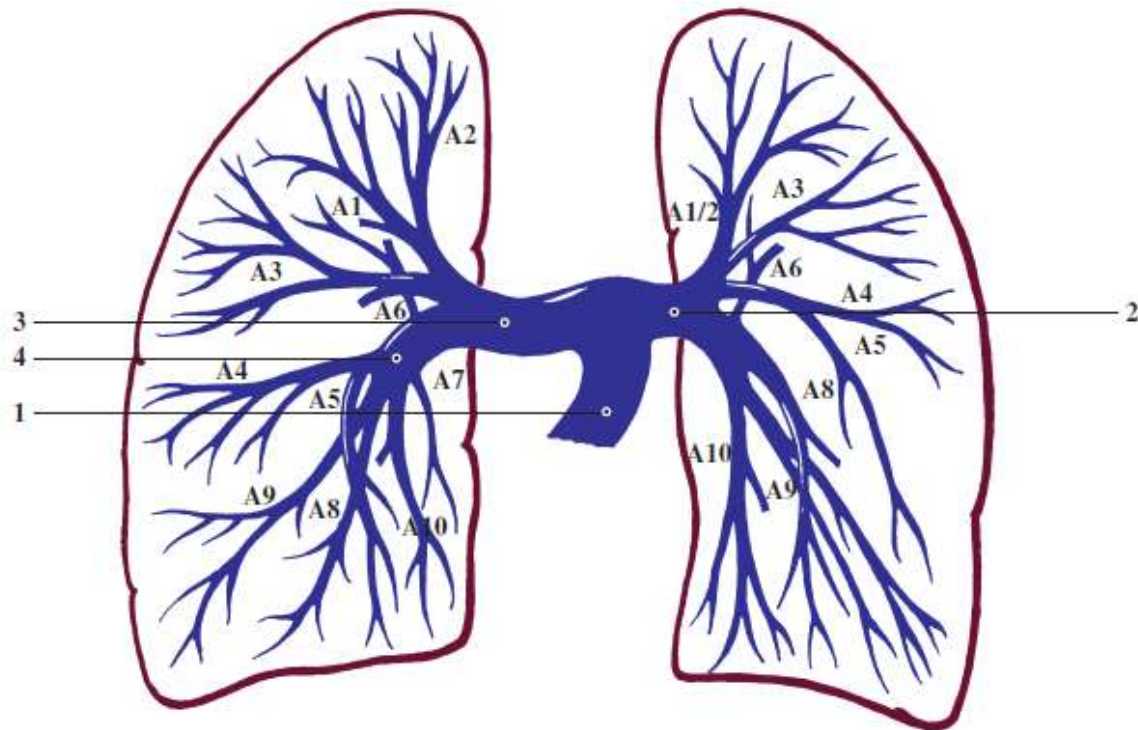
LUNG CIRCULATION



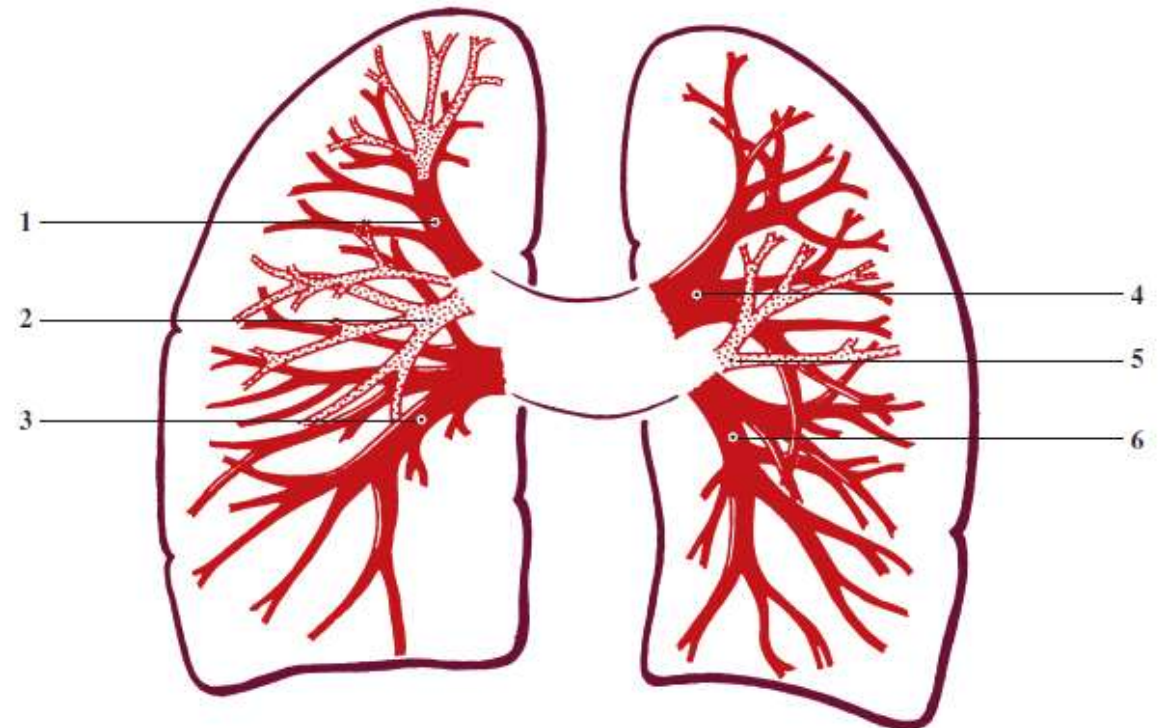
PULMONARY ARTERIES AND VEINS

- ♦ Arteries following segmentary organization
- ♦ Veins connected in several stems, different course than arteries in hilar region

In wall of pulmonary veins – functional myocytes of myocardium - arrhythmias



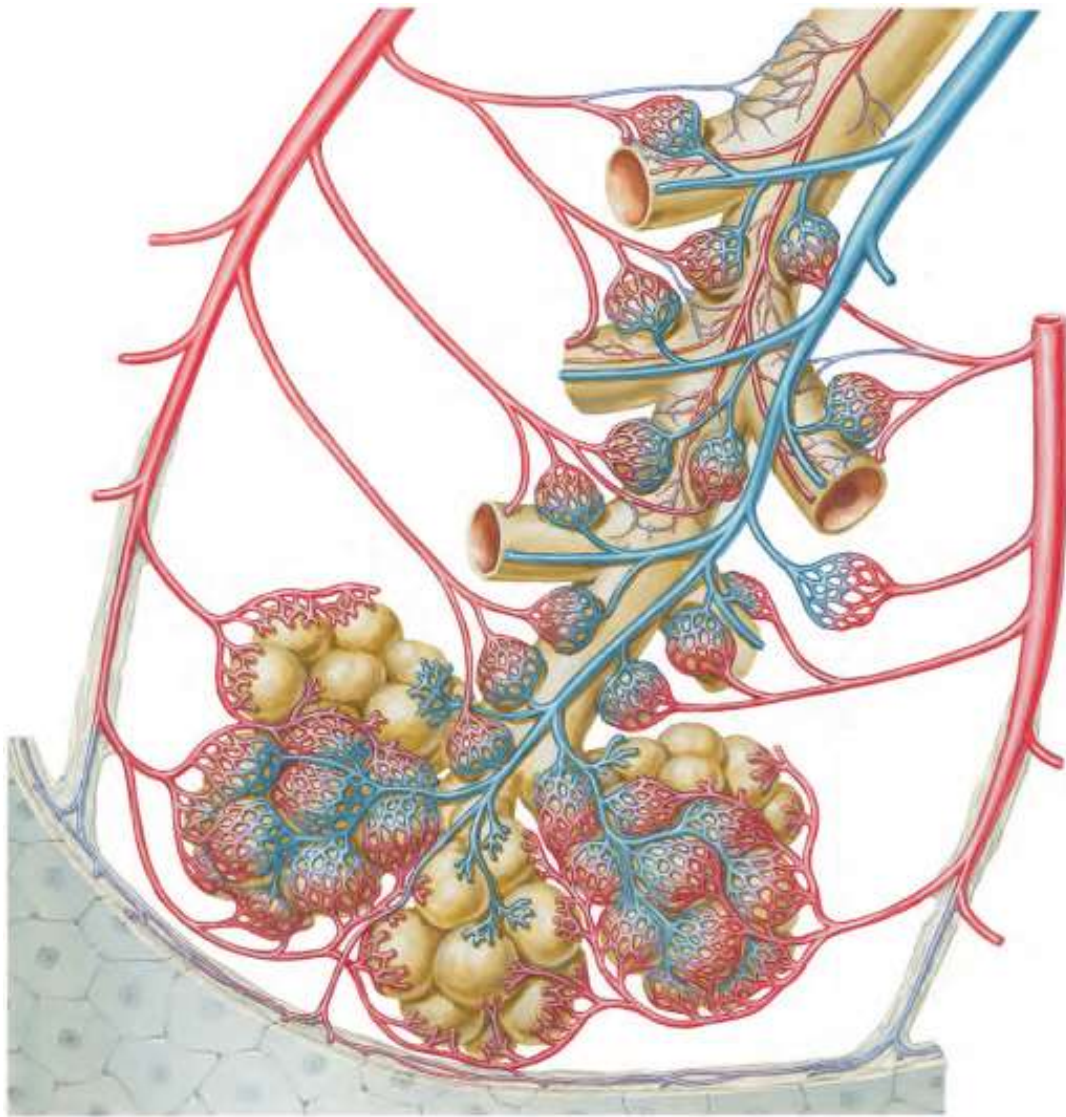
Obr. 4.1. Anatomie plicnice – schéma. 1 – a. pulmonalis – truncus; 2 – r. sinister; 3 – r. dexter; 4 – truncus intermedius; A1 až A10 – segmentární tepny



Obr. 4.2. Anatomie plicních žil – schéma. 1 – v. pulmonalis superior dextra; 2 – v. pulmonalis media dextra; 3 – v. pulmonalis inferior dextra; 4 – v. pulmonalis superior sinistra; 5 – v. pulmonalis media sinistra; 6 – v. pulmonalis inferior sinistra



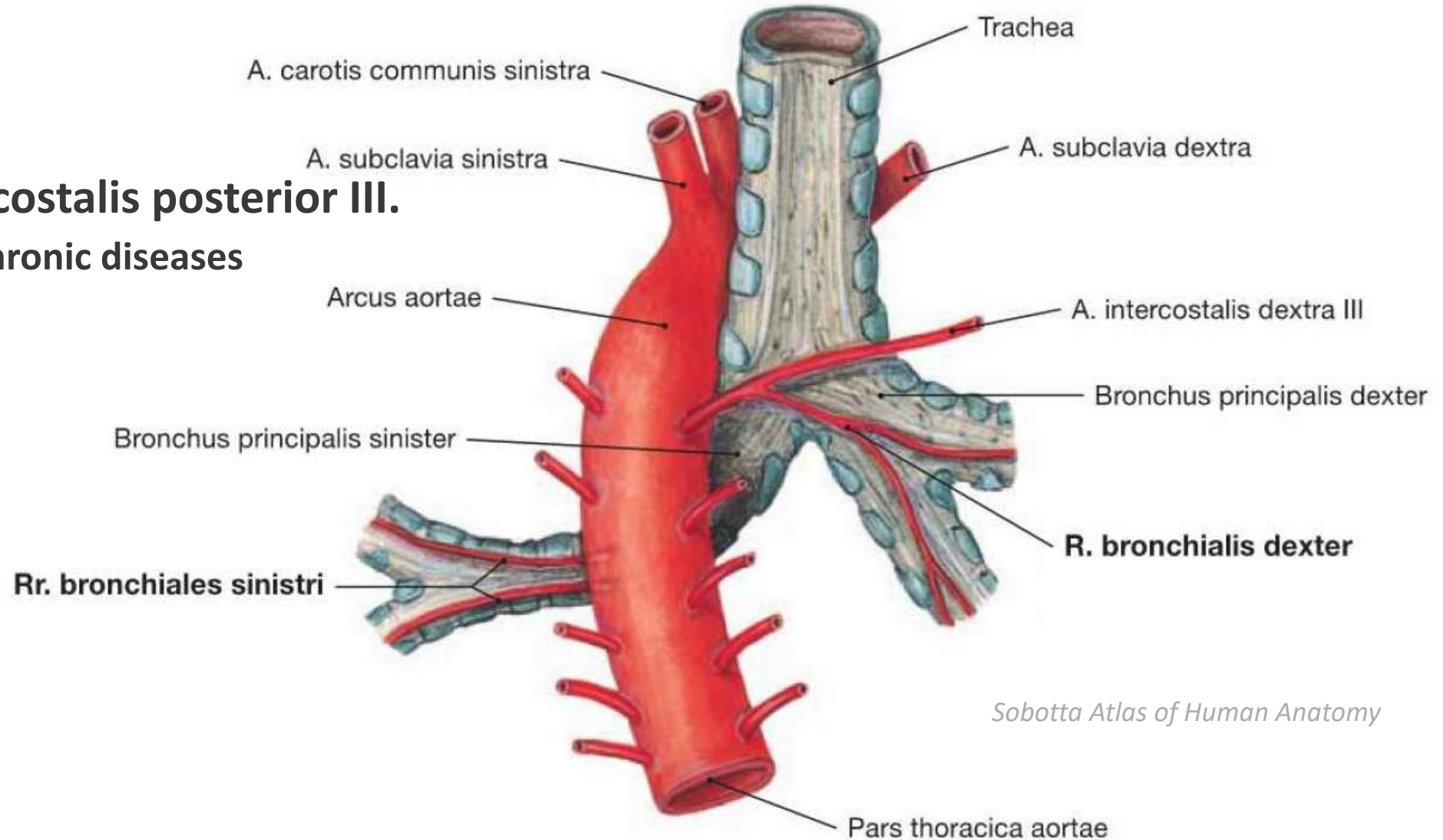
PULMONARY CIRCULATION



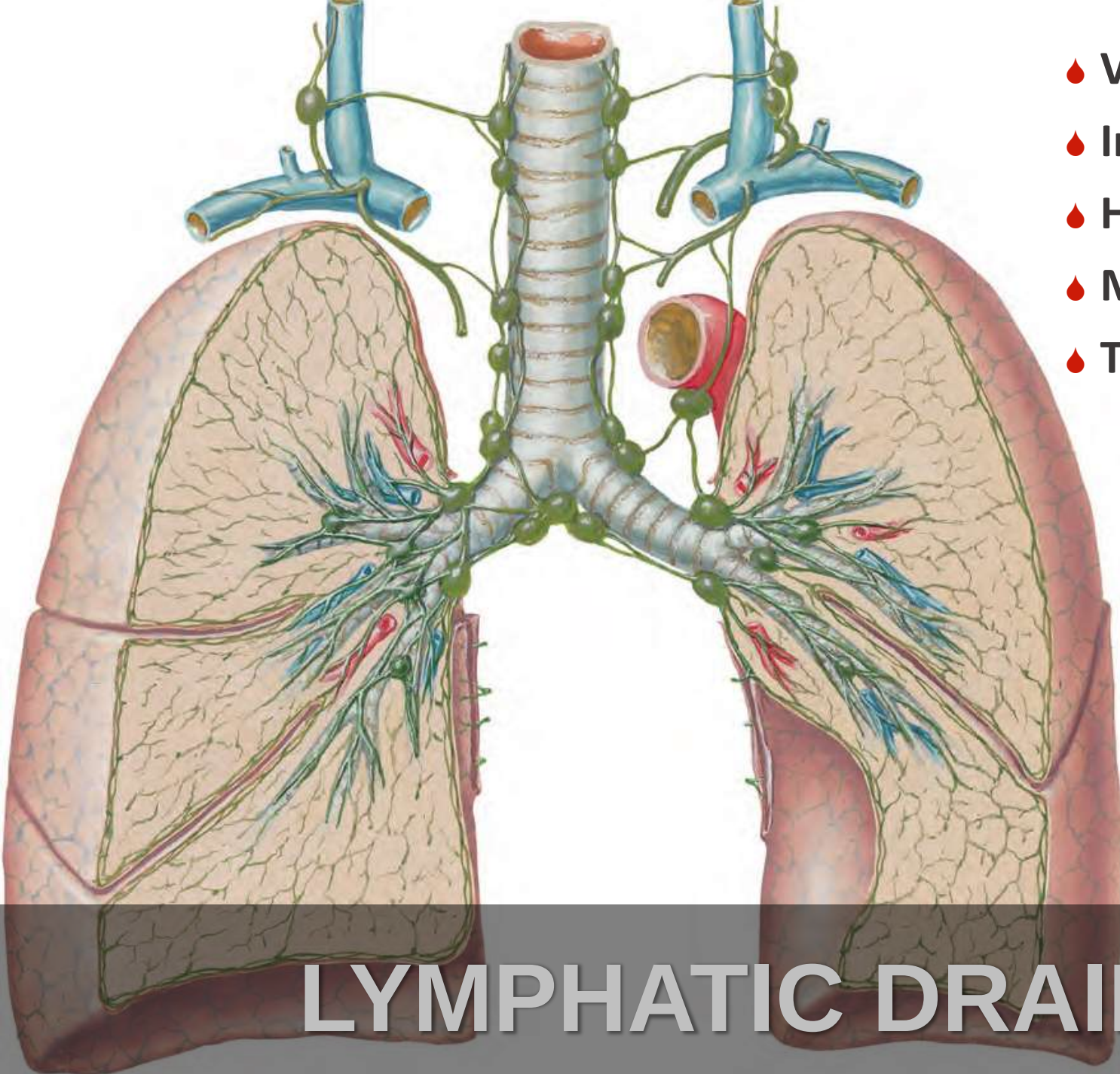
- ♦ **A. pulmonalis**
- ♦ **Ramus sinister**
- ♦ **Ramus dexter**
- ♦ **Rami lobares**
- ♦ **Rami segmentares**
- ♦ **Rami subsegmentales**
- ♦ **Rami lobulares**
- ♦ **Rete capillare**
- ♦
- ♦
- ♦ **V. pulmonalis**

CIRCULATION

- **A. bronchialis**
- **Left from aorta**
- **Mainly two**
- **Right from a. intercostalis posterior III.**
 - **Hypertrophic in chronic diseases**
- **bleeding**
- **hemoptysis**



BRONCHIAL ARTERIES

- 
- ♦ Vasa lymphatica
 - ♦ Intrapulmonal lymph nodes
 - ♦ Hilar nodes
 - ♦ Mediastinal nodes
 - ♦ Truncus bronchomediastinales

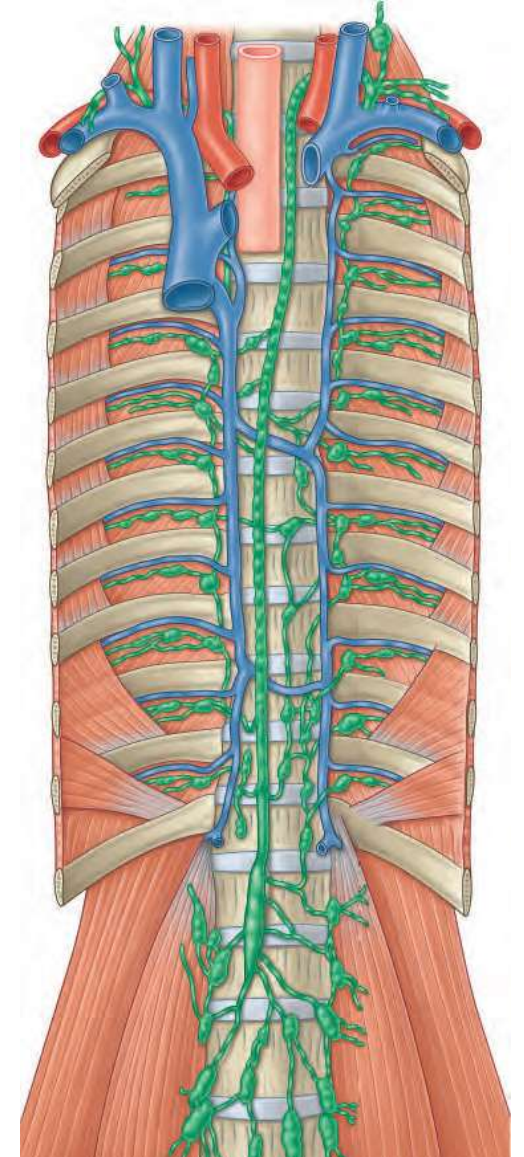
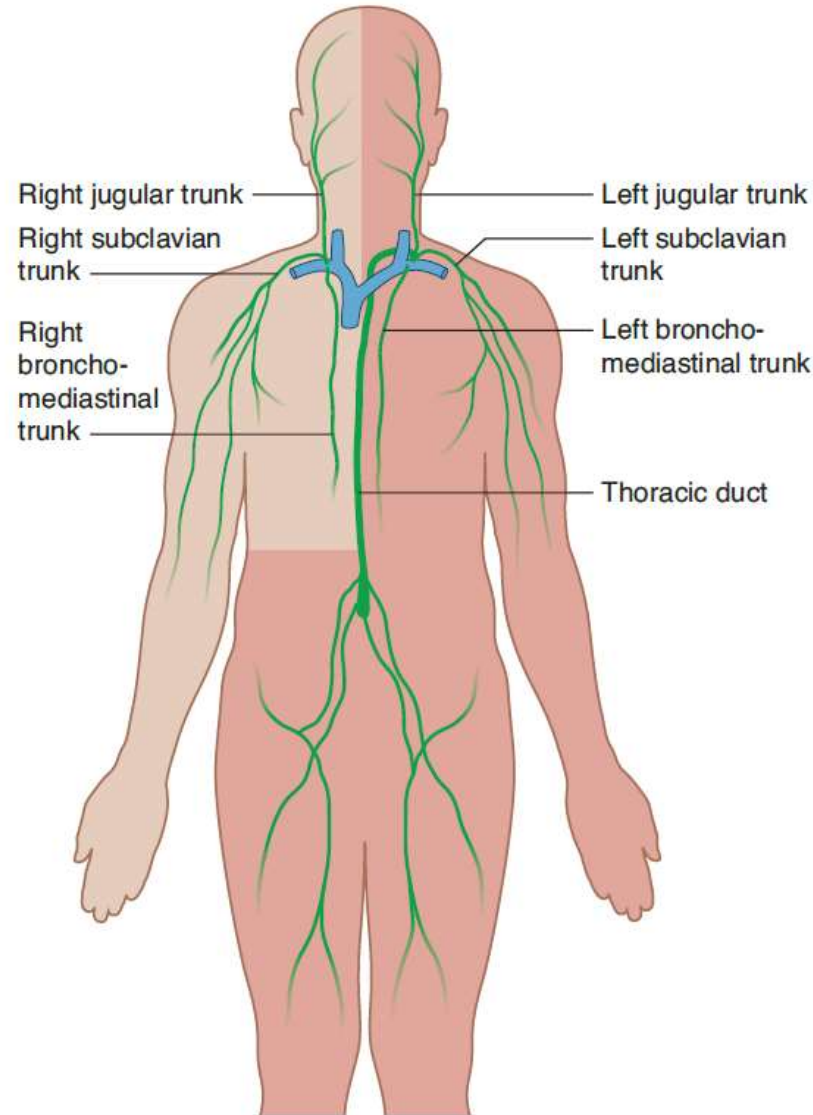
LYMPHATIC DRAINAGE

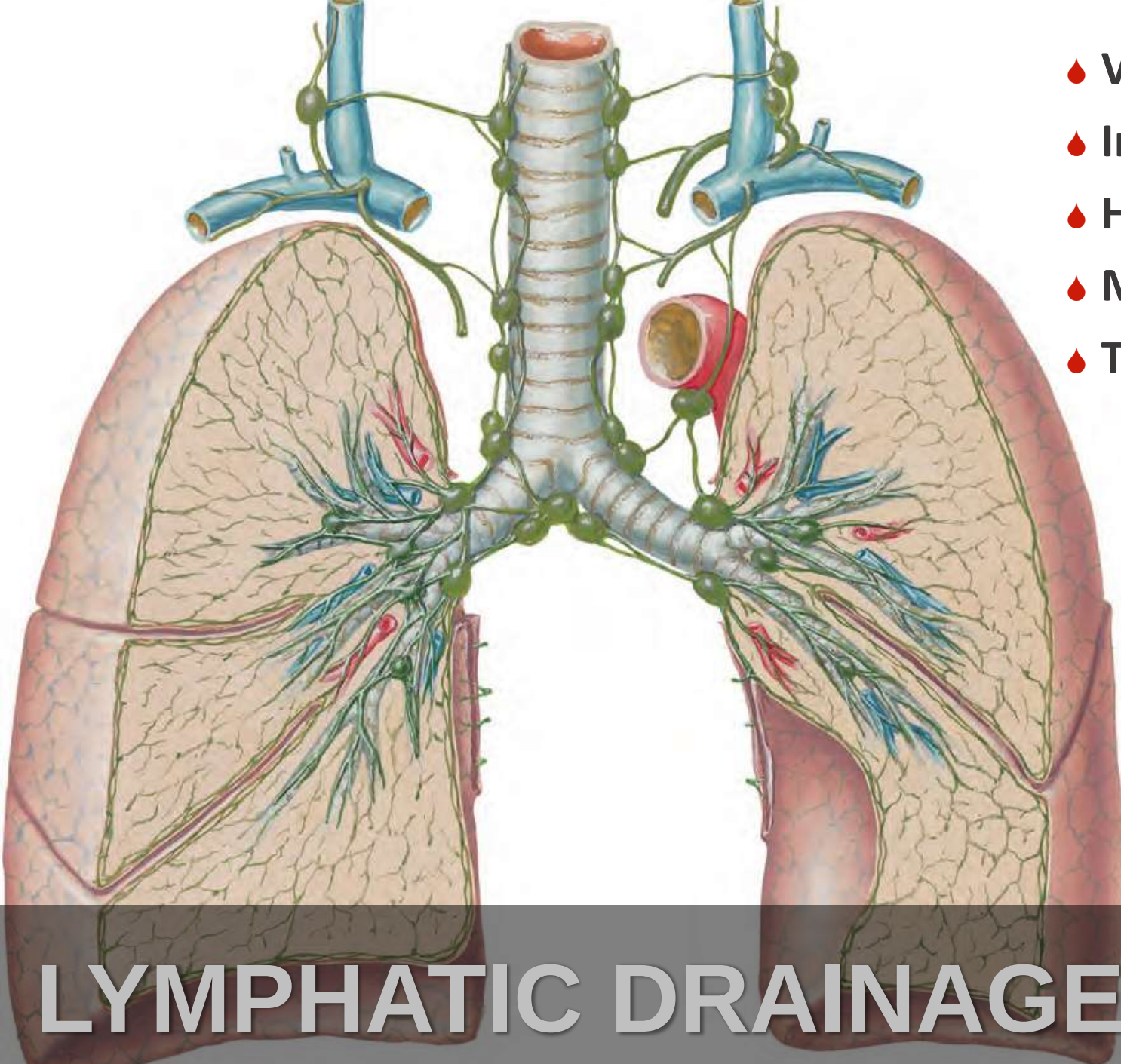
Thorax – lymphatic system

Prof. MUDr. Jiří Ferda, Ph.D.

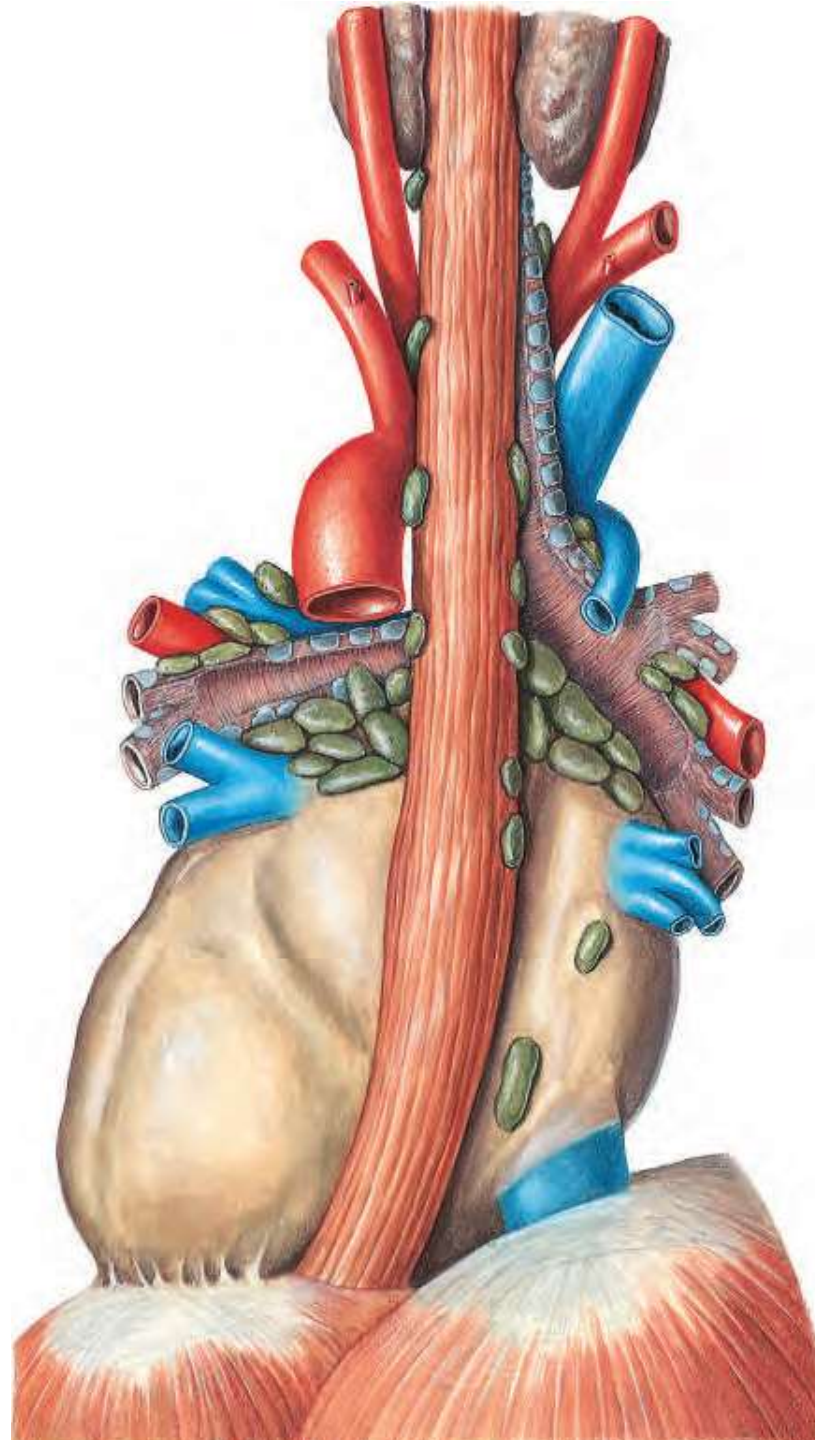
MAIN LYMPHATIC

- ♦ *Trunci lumbales*
- ♦ *Trunci intestinales*
- ♦ *Cisterna chyli*
- ♦ **Ductus thoracicus (hiathus aorticus)**
- ♦ *Tr. brochomediastinalis sinister*
- ♦ *Tr. subclavius sinister*
- ♦ *Tr. jugularis sinister*
- ♦ **Angulus venosus sinister (3/4 těla)**
- ♦ *Tr. brochomediastinalis sinister*
- ♦ *Tr. subclavius sinister*
- ♦ *Tr. jugularis sinister*
- ♦ *Tr. lymphaticus dexter*
- ♦ *Angulus venosus dexter (1/4 těla)*



- 
- The diagram illustrates the lymphatic drainage system of the lungs. It shows the trachea and bronchi in the center, with the lungs on either side. The lymphatic system is depicted with green lines and nodes. The nodes are arranged in a hierarchical manner, starting from the intrapulmonary nodes within the lung tissue, moving to the hilar nodes at the base of the lungs, then to the mediastinal nodes along the trachea, and finally to the truncus bronchomediastinales at the top. The vasa lymphatica are shown as small green vessels branching out from the nodes. The diagram also shows the pulmonary arteries and veins in red and blue, providing a clear anatomical context for the lymphatic system.
- ♦ Vasa lymphatica
 - ♦ Intrapulmonal lymph nodes
 - ♦ Hilar nodes
 - ♦ Mediastinal nodes
 - ♦ Truncus bronchomediastinales

LYMPHATIC DRAINAGE OF LUNGS



Station Description according to Gray's Anatomy

1. The highest mediastinal nodes

lying above a horizontal line, at which level the left brachiocephalic vein crosses the trachea

2. Upper paratracheal nodes

lying below the line of the highest mediastinal nodes and above a line drawn horizontally at the level of the upper border of the aortic arch

3. Prevascular and retrotracheal nodes

lying behind the trachea but in front of the great vessels

4. Lower paratracheal nodes

lying below the upper margin of the aortic arch and down to the upper margin of the corresponding upper lobe bronchus. On the right side, this is the upper margin of the right upper lobe bronchus; the majority of nodes in this area tend to be positioned anterolateral to the trachea. On the left side, the nodes are located below the upper margin of the aortic arch and above the margin of the left upper lobe bronchus. They lie to the right of the ligamentum arteriosum, between the ligament and the trachea

5. Subaortic nodes

lying in the aortopulmonary window and situated to the right of the ligamentum arteriosum, aorta or left pulmonary artery, but proximal to the first division of the left pulmonary artery

6. Para-aortic nodes

lying between the upper margin of the aortic arch and lateral to the ascending aorta and aortic arch

7. Subcarinal nodes

are not associated with the lower lobe bronchi

8. Para-oesophageal

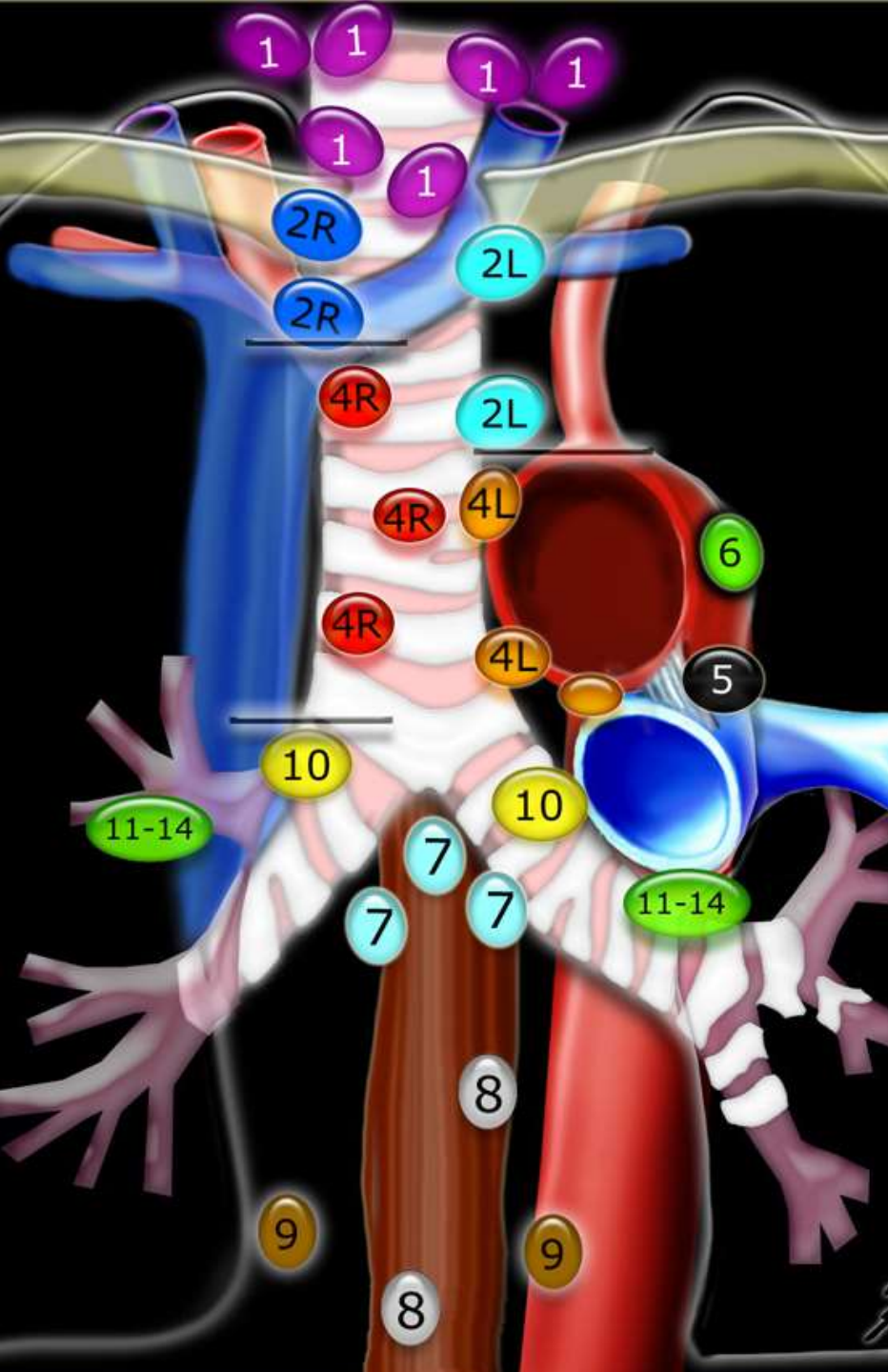
nodes lie well below the subcarinal nodes, close to the pulmonary veins

9. Nodes lying within the pulmonary ligament

10. Hilar node

11. Interlobar nodes

12. Lobar nodes



Station Description according to Gray's Anatomy

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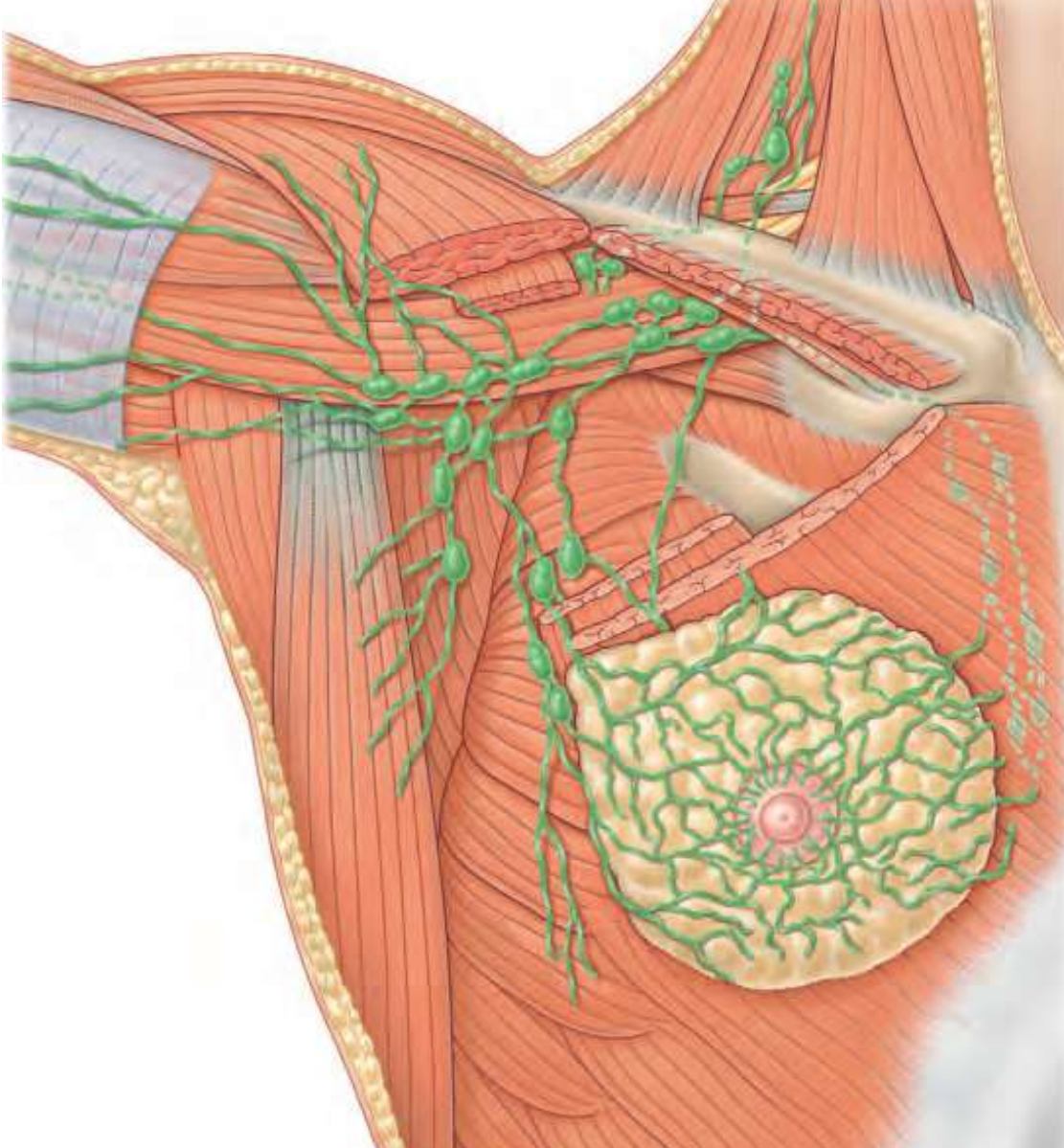
nodes lie well below the subcarinal nodes, close to the pulmonary veins

9. Nodes lying within the pulmonary ligament

10. Hilar node

11. Interlobar nodes

12. Lobar nodes



- ♦ intramammary
- ♦ axillary
- ♦ I., II., a III. etage
- ♦ supraclavicular

- ♦ Intrathoraintrathoracalkální
- ♦ along vasa thoracica interna

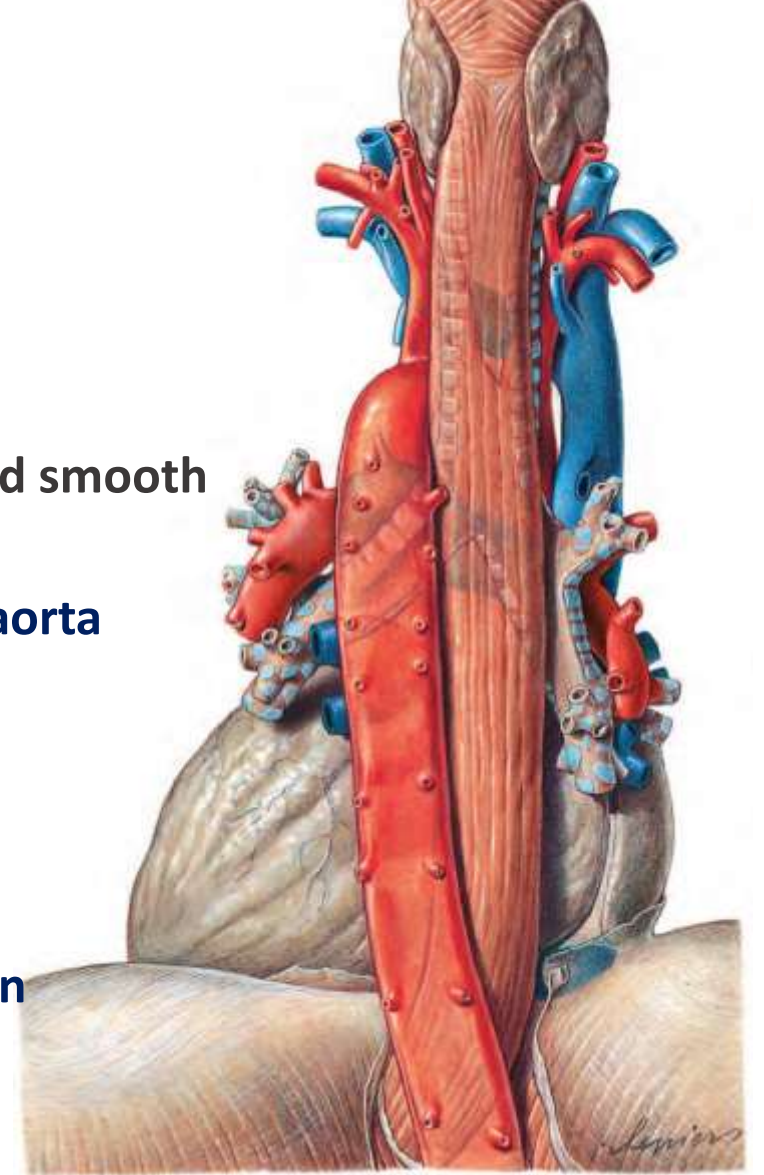
BRAST LYMPHATICS

Thorax – thymus, esophagus

Prof. MUDr. Jiří Ferda, Ph.D.



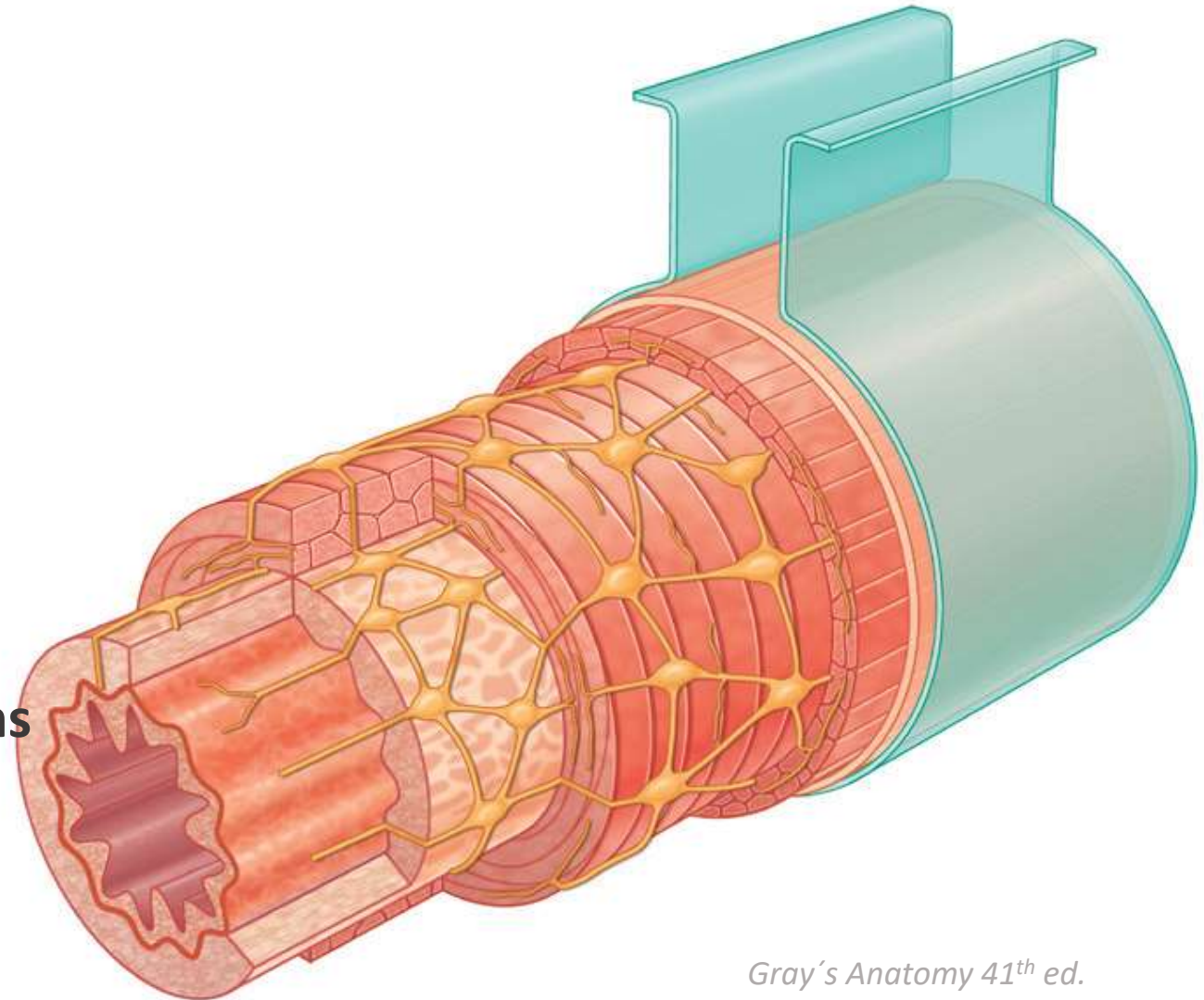
- ♦ **Pars cervicalis**
 - ♦ Stripped muscles
 - ♦ Thinner point – sphincter of Kilian
- ♦ **Pars thoracica**
 - ♦ Stripped in upper third
 - ♦ Middle third – combination of stripped and smooth
 - ♦ Lower third smooth
 - ♦ Thinner point – crossing of bronchus and aorta
 - ♦ Thinner point - hiatus oesophagealis
- ♦ **Pars abdominalis**
 - ♦ smooth
 - ♦ Thinner point – cardioesophageal junction

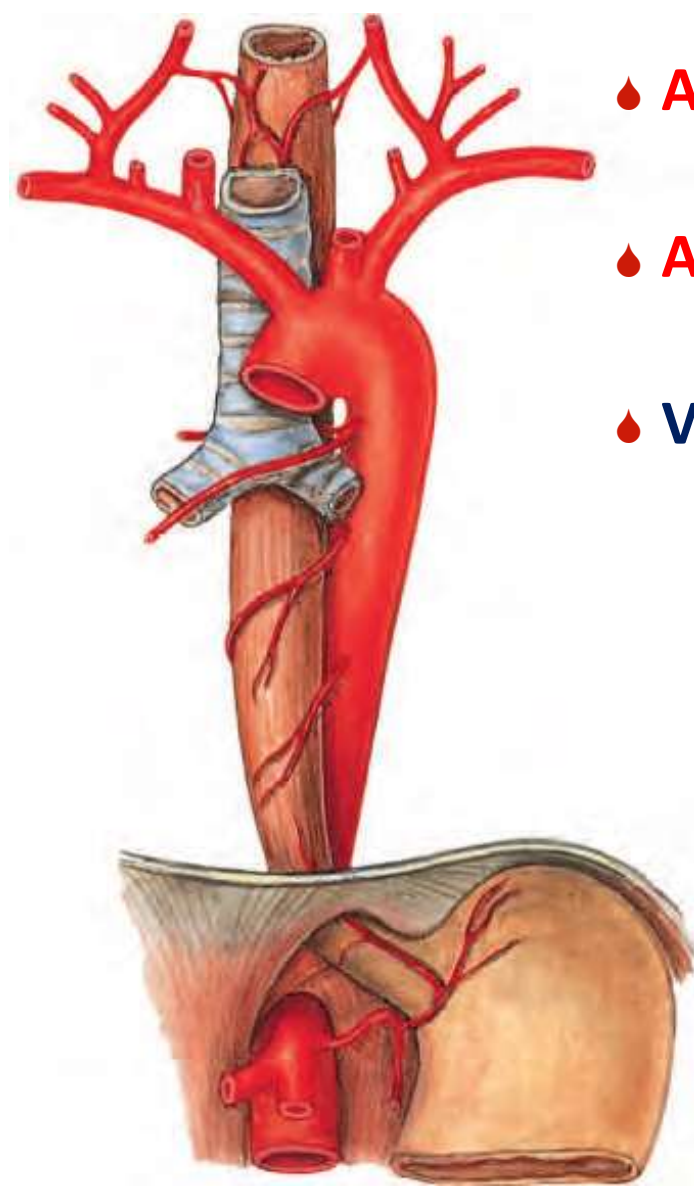


OESOPHAGUS

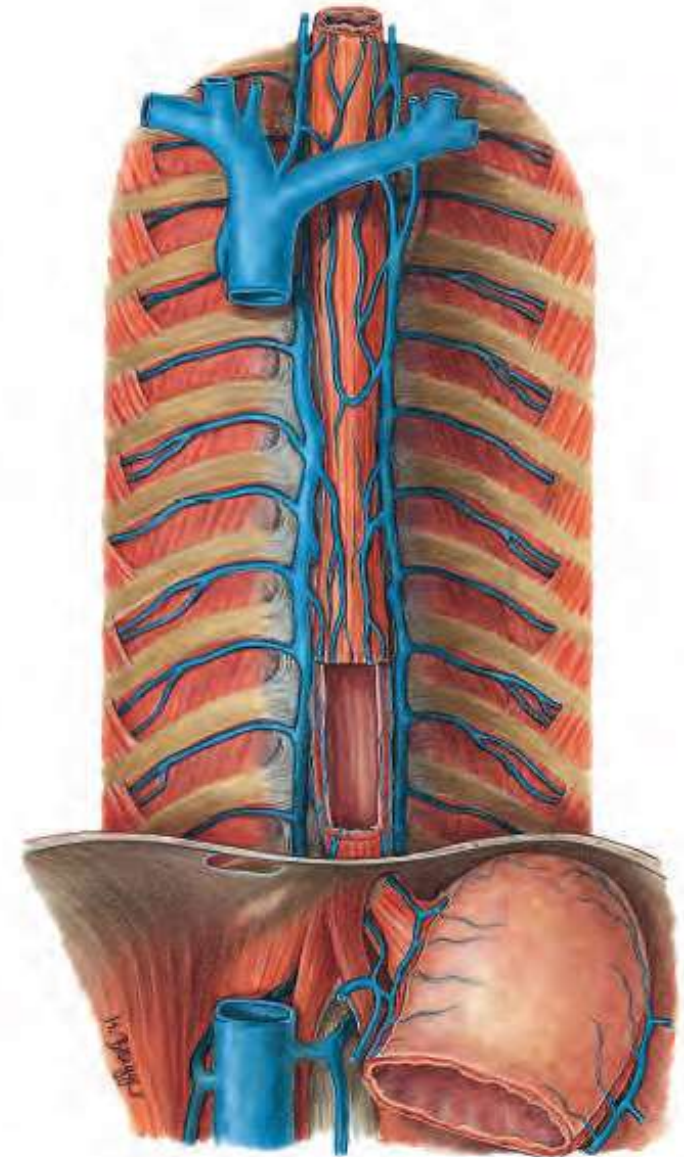
TUNICA MUSCULARIS

- Upper third somatomotoric innervation
- Middle third mixed innervation
- Lower third visceromotoric innervation
- Stratum circulare
- plexus myentericus
- Stratum longitudinale
- Local contractions and peristaltic motions

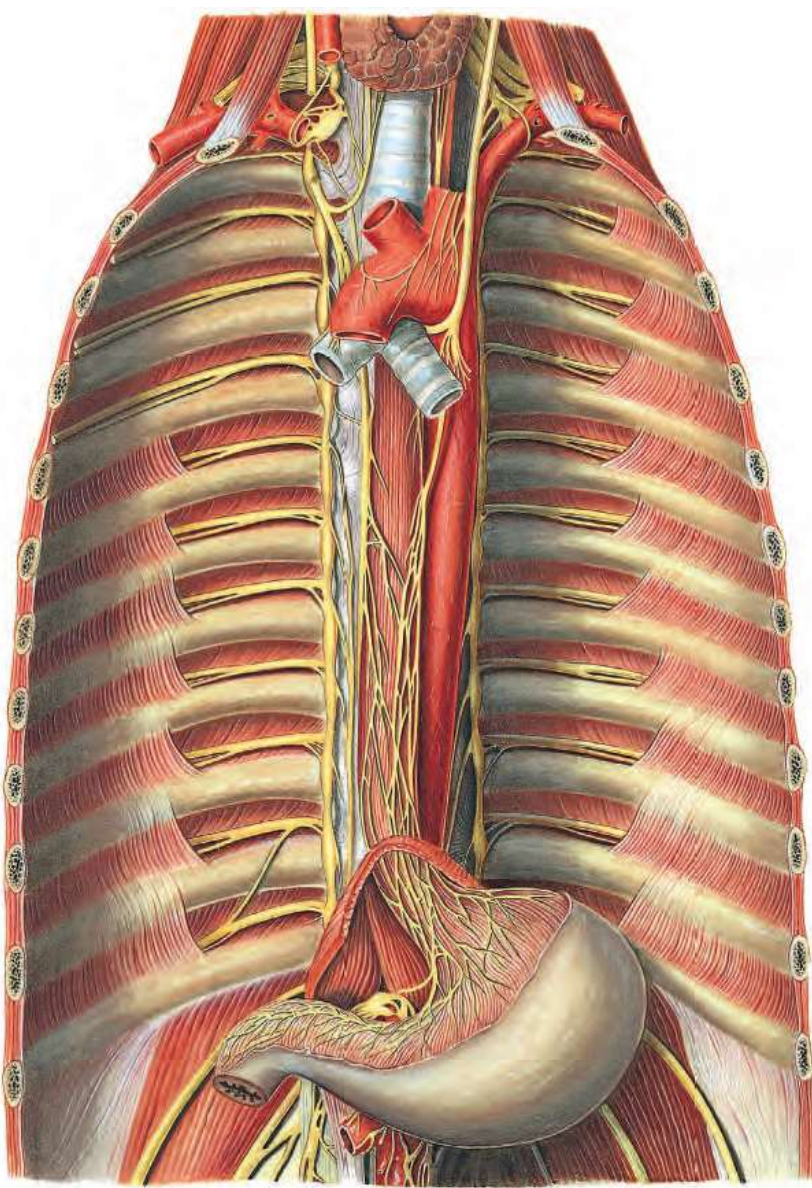




- ♦ **Aorta thoracica descendens**
 - ♦ Rami oesophaeales
- ♦ **A. gastrica sinistra**
 - ♦ Rami oesophageales
- ♦ **V. azygos-hemiazygos**
 - ♦ Plexus venosus oesophagealis
 - ♦ varices oesophageles – portal hypertension
 - ♦ Spojky
 - ♦ V. cardiales
 - ♦ V. gastrica sinistra
 - ♦ Vv. gastricae breves
 - ♦ V. lienalis



OESOPHAGUS



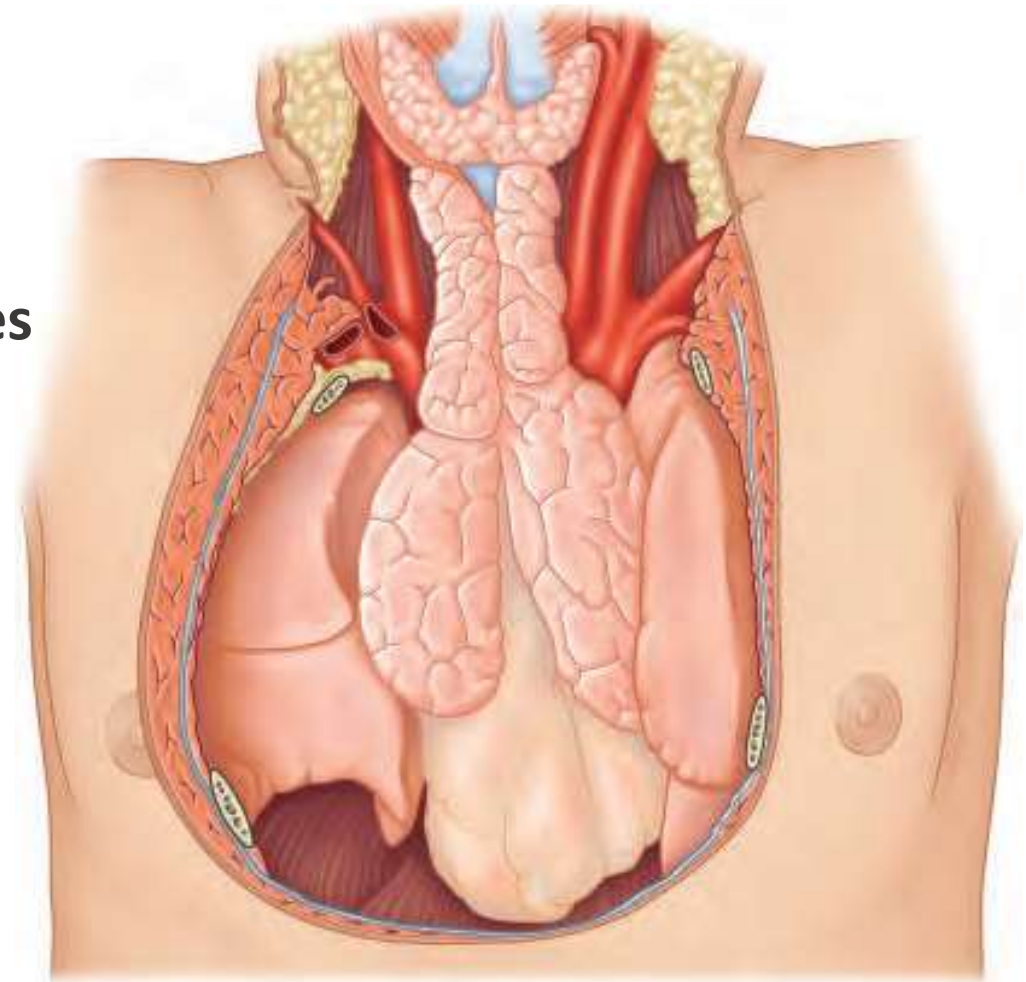
♦ Nervus vagus X

- ♦ Nervus laryngeus recurrens
 - ♦ arcus aortae
- ♦ Nervus laryngeus dexter
 - ♦ A. subclavia dextra
- ♦ Plexus oesophagealis
- ♦ Truncus vagalis anterior
- ♦ Truncus vagalis superior

OESOPHAGUS

THYMUS

- ♦ **Lymphoepitelial organ**
 - ♦ anterior mediastinum
 - ♦ In the front of aorta
 - ♦ Below left brachiocephalis vein
- ♦ **Substantia corticalis, medullaris, Hassal corpuscles**
- ♦ **Lobuli thymi**
- ♦ **Source of T-lymfocytes – cellular immunity**
- ♦ **Thymosin**
 - ♦ Hormonal stimulation of growth and ripening of T-ly
- ♦ **size**
 - ♦ Before deliverance 16 g after birth loss of weight
 - ♦ 2-3 y 37 g – *growing period*
 - ♦ To pubertas 37 g – *maximal growth period*
 - ♦ to 50 y – *involution and fatty infiltration*



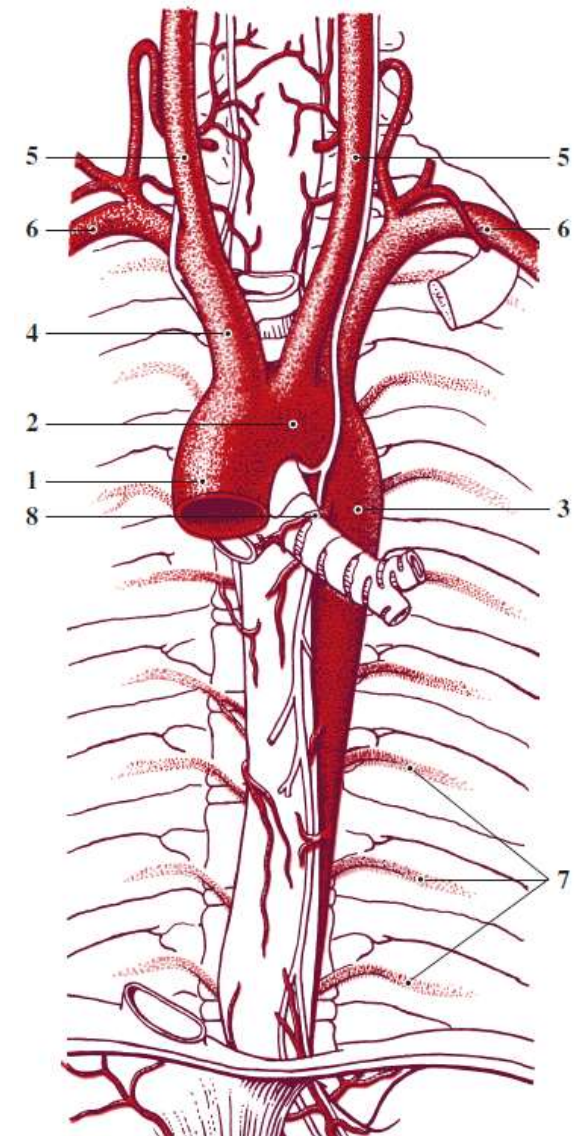
thymus neonati - extensiones cervicales

Thorax – aorta, great vessels and nerves

Prof. MUDr. Jiří Ferda, Ph.D.

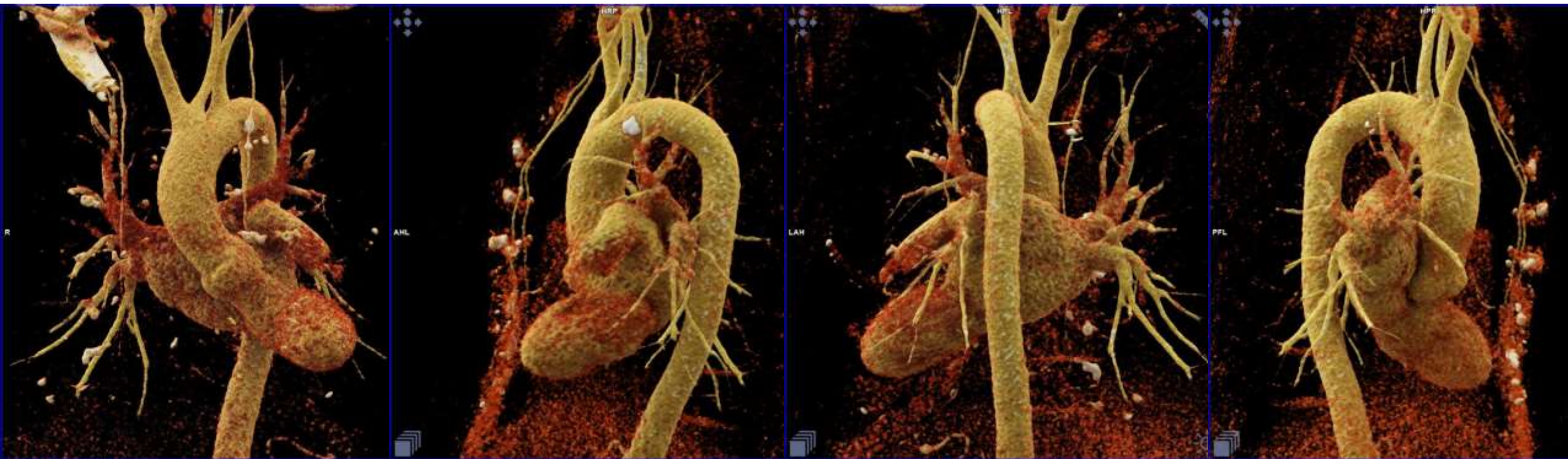


- 🔴 Aortic root
- 🔴 Aorta ascendens
- 🔴 Arcus aortae
- 🔴 Aorta descendens
- 🔴 Hiatus aorticus
 - 🔴 Th12



AORTA THORACICA

AORTA





- ♦ Arch is going to left
- ♦ Descendent aorta
 - ♦ Th4/5
- ♦ Isthmus aortae - ligamentum arteriosum

ARCUS AORTAE

- ♦ **Aa. coronariae**
- ♦ **Truncus brachiocephalicus**
 - ♦ **A. subclavia dextra**
 - ♦ **A. carotis communis dextra**
- ♦ *A. thyroidea ima*
- ♦ **A. carotis communis sinistra**
- ♦ *A. vertebralis sinistra*
- ♦ **A. subclavia sinistra**
- ♦ **Aa. intercostales post.**
- ♦ **Aa. bronchiales**
- ♦ *Rr. mediastinales, oesophageales, pericardiaci*



BRANCHES OF AORTA



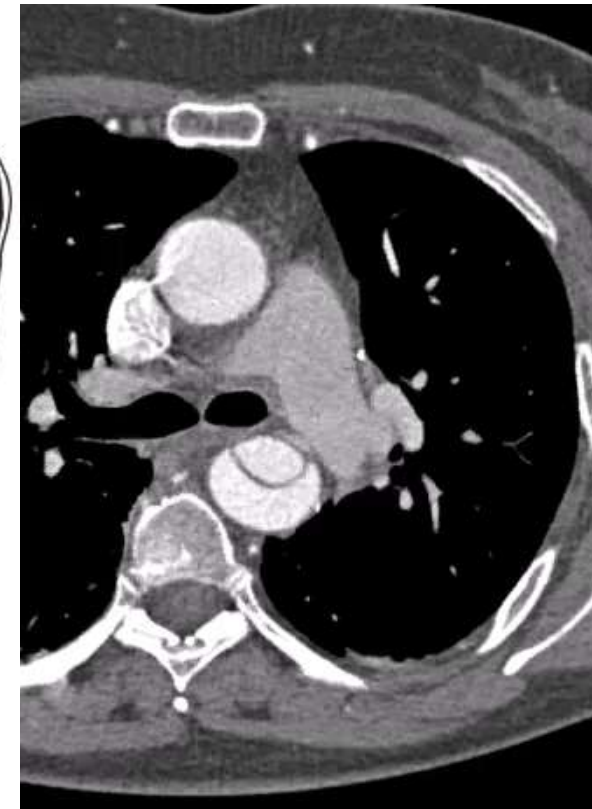
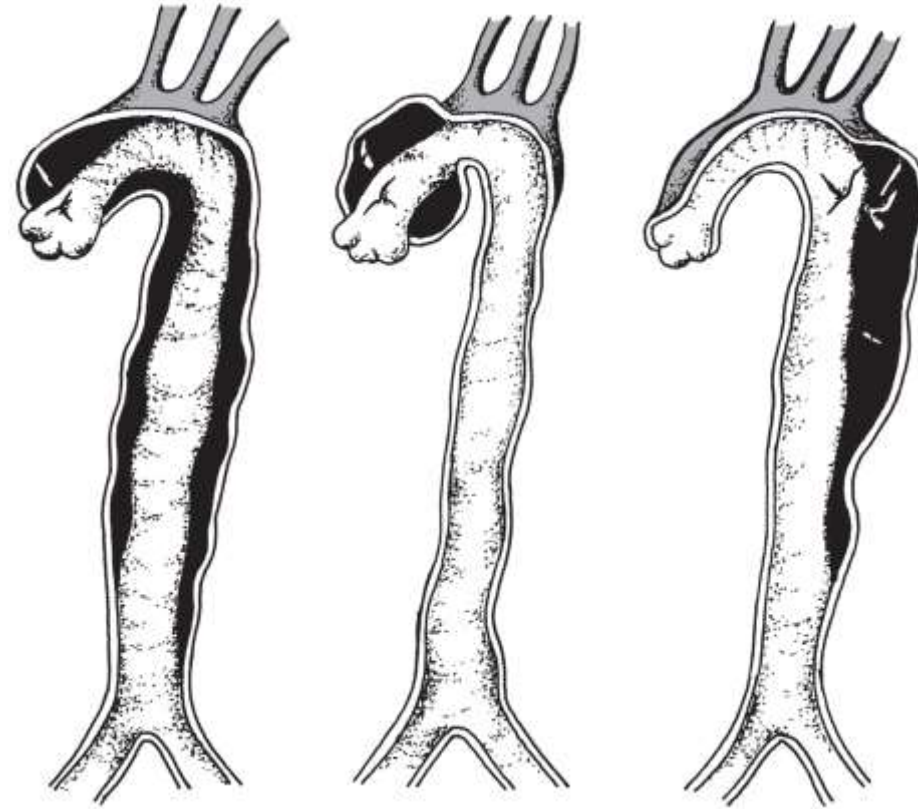
- **ligamentum arteriosum**
- **Congenital stenoses**
- **Aortic coarctation**
- **Aortic injury**
- **Anatomical point to assess involvement extent**
- **Stanford classification**



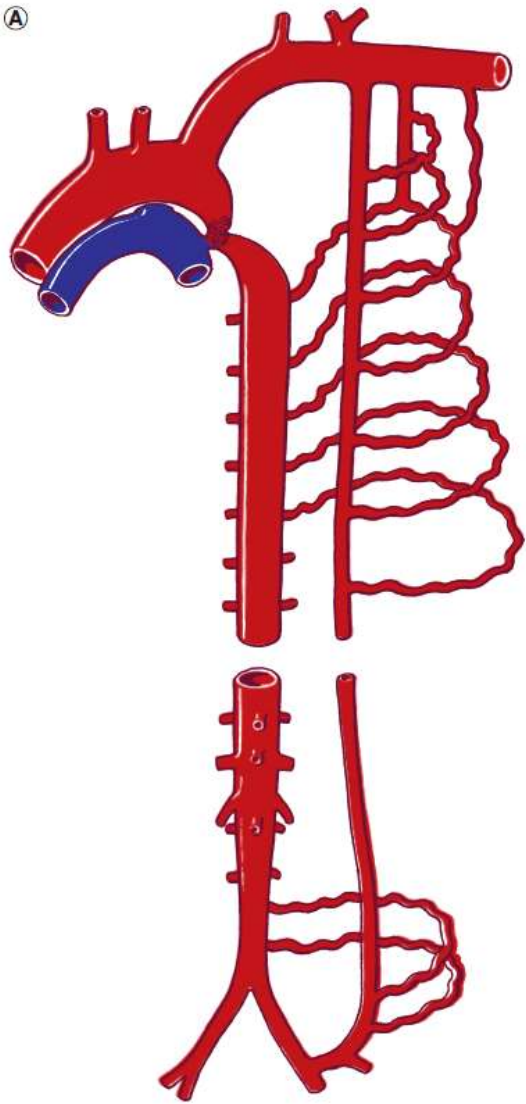
ISTHMUS AORTAE



- 🔴 Point to arise of a. subclavia sinistra
- 🔴 DeBakey x Stanford (A, B)



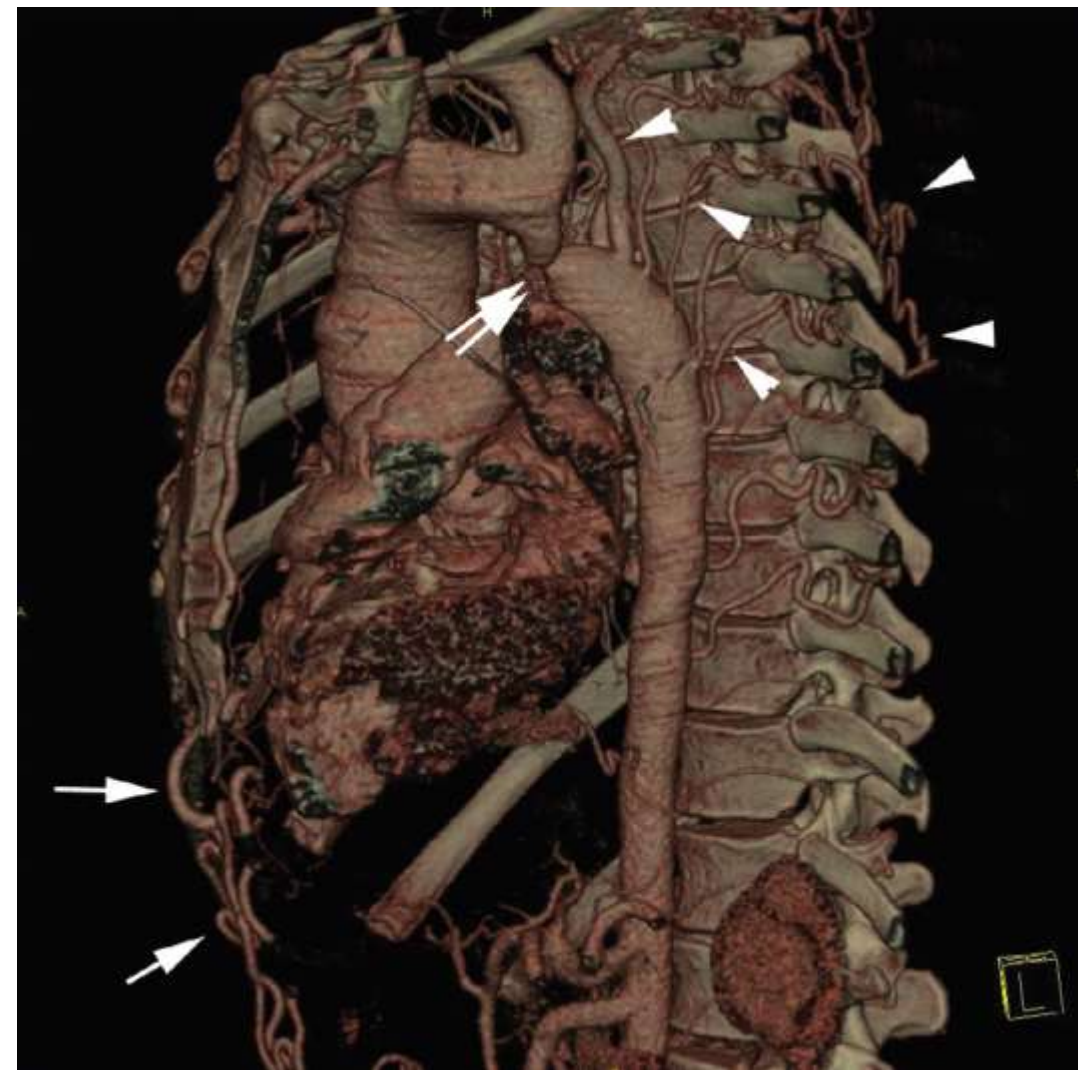
ANATOMIC CRITERIA OF AORTIC PATH.



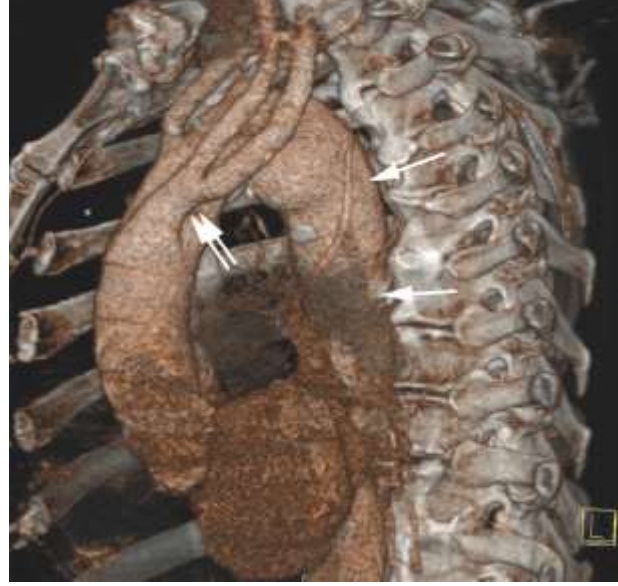
🔴 stenosis

🔴 In isthmus

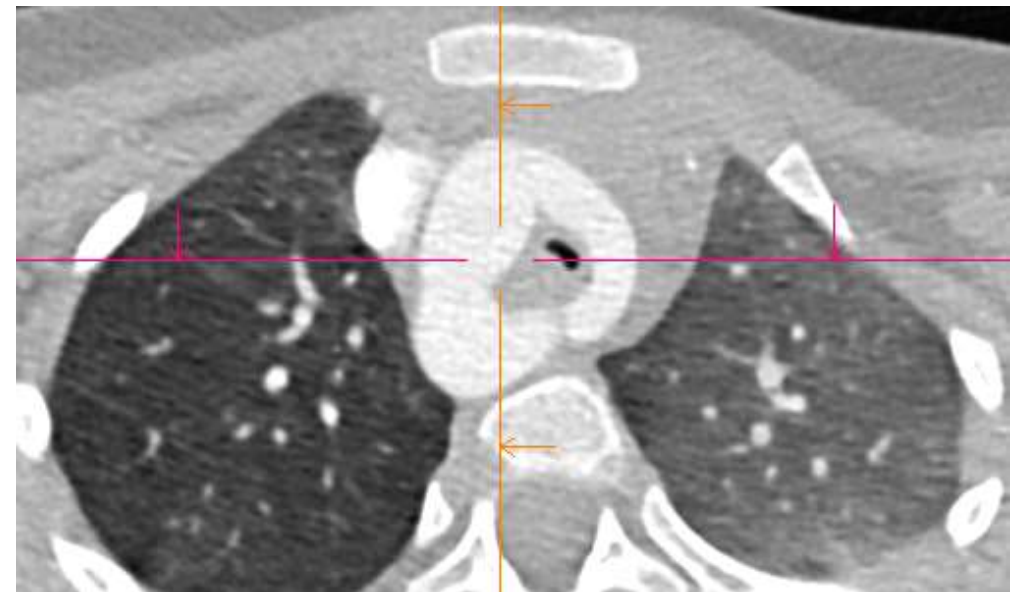
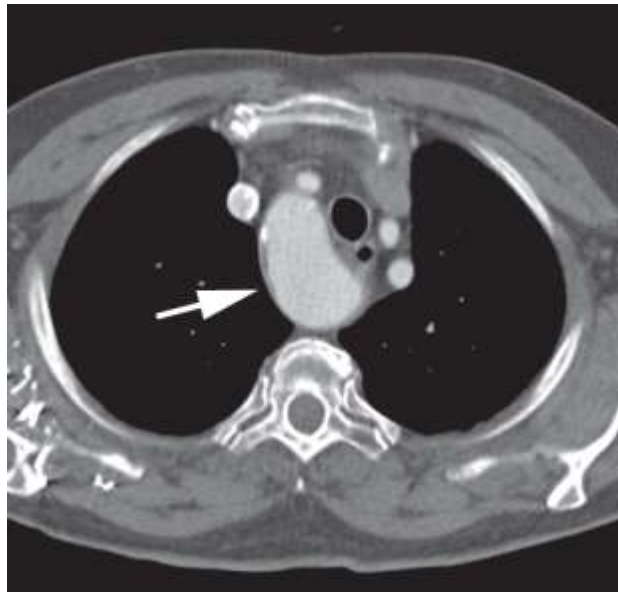
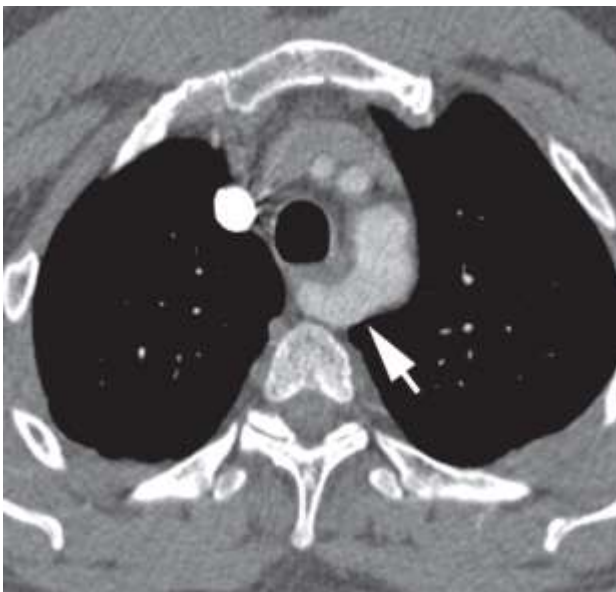
🔴 Collateral circulation



KOARKTACE AORTY



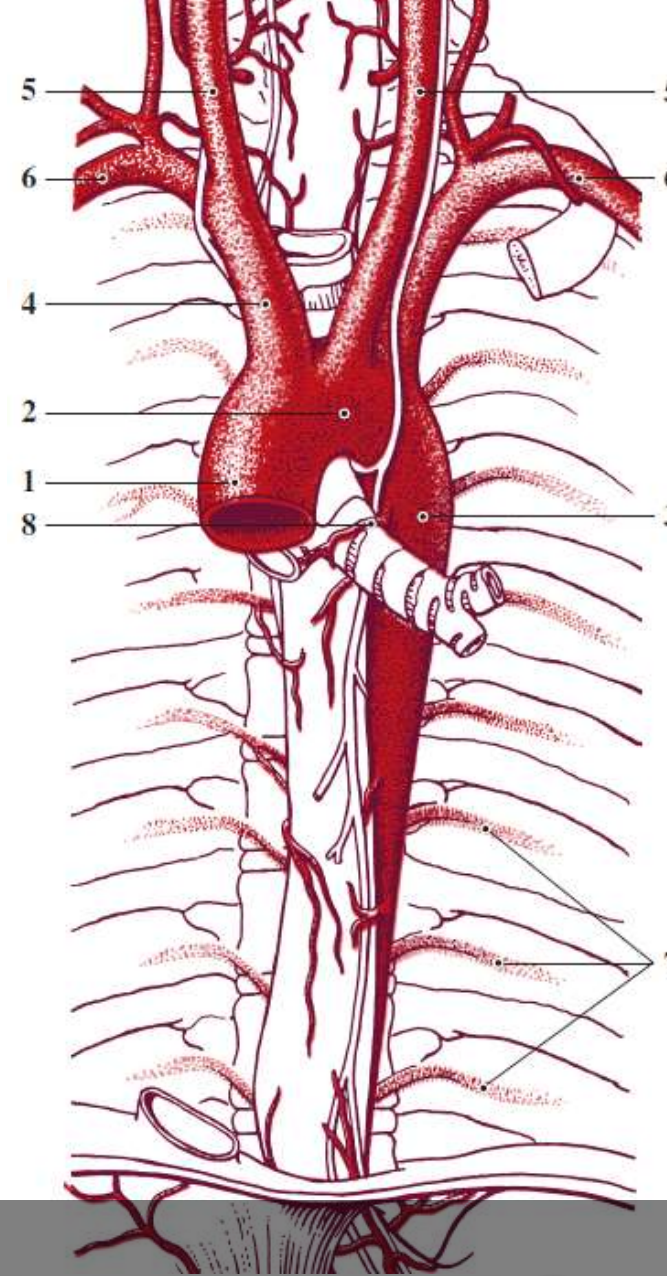
- ♦ Variants of branches
- ♦ A. lusoria
- ♦ Right sided arch
- ♦ Aortic ring
 - ♦ complete
 - ♦ incomplete



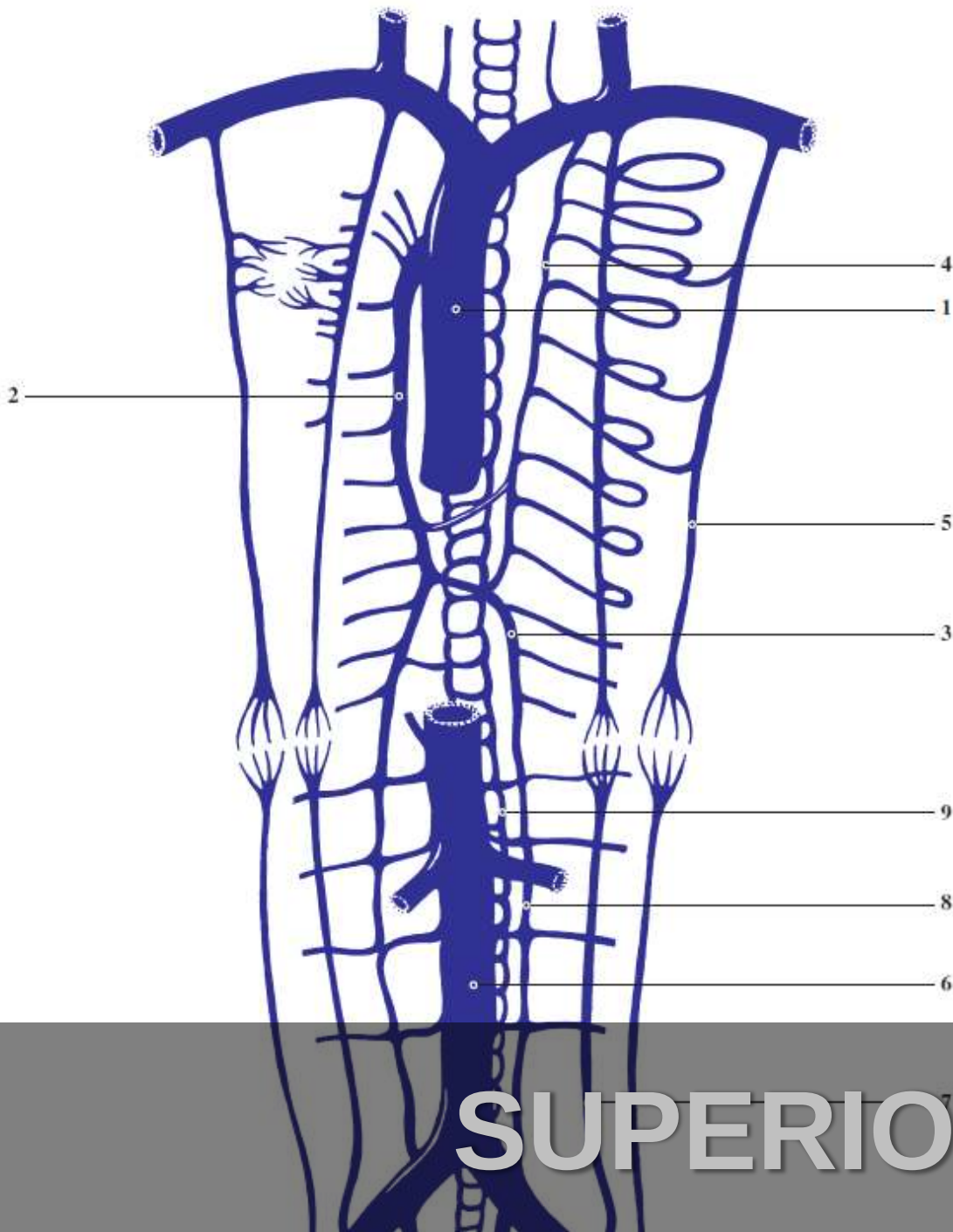
ANATOMIC VARIANTS



- 🔥 Aa. intercostales posteriores
- 🔥 Aa. subcostales
- 🔥 aa. phrenicae superiores
- 🔥 Rami mediastinales
- 🔥 Rami oesophageales
- 🔥 Rami pericardiales
- 🔥 Aa. bronchiales (vlevo)



PARIETAL AND VISCERAL BRANCHES



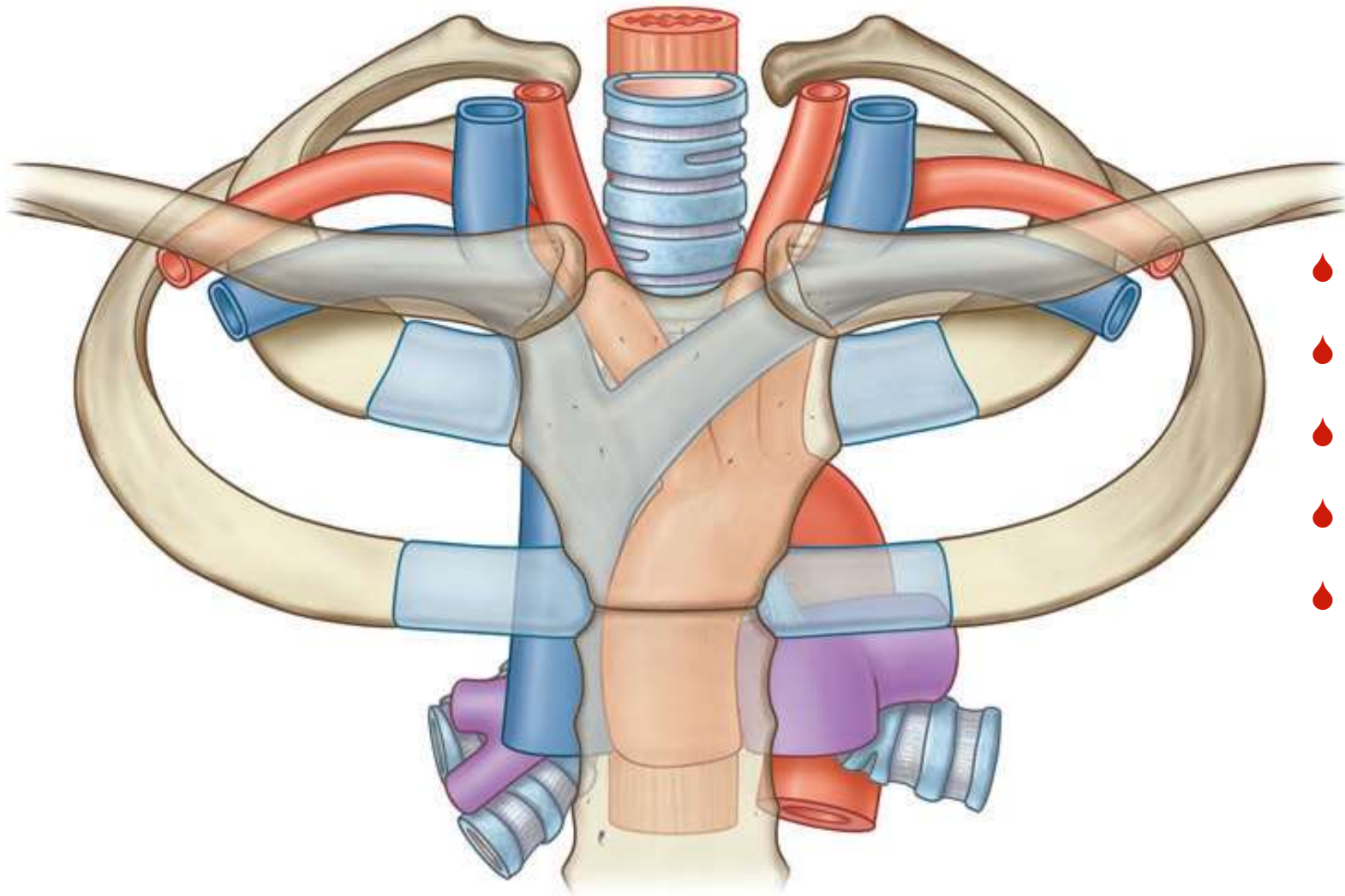
- Forms by confluens of
- V. brachiocephalica sinistra
- V. brachiocephalica dextra
- intake v. azygos
- Anomalous pulmonary veins
- Blood flows in venous part of atrium dx.

SUPERIOR VENA CAVA



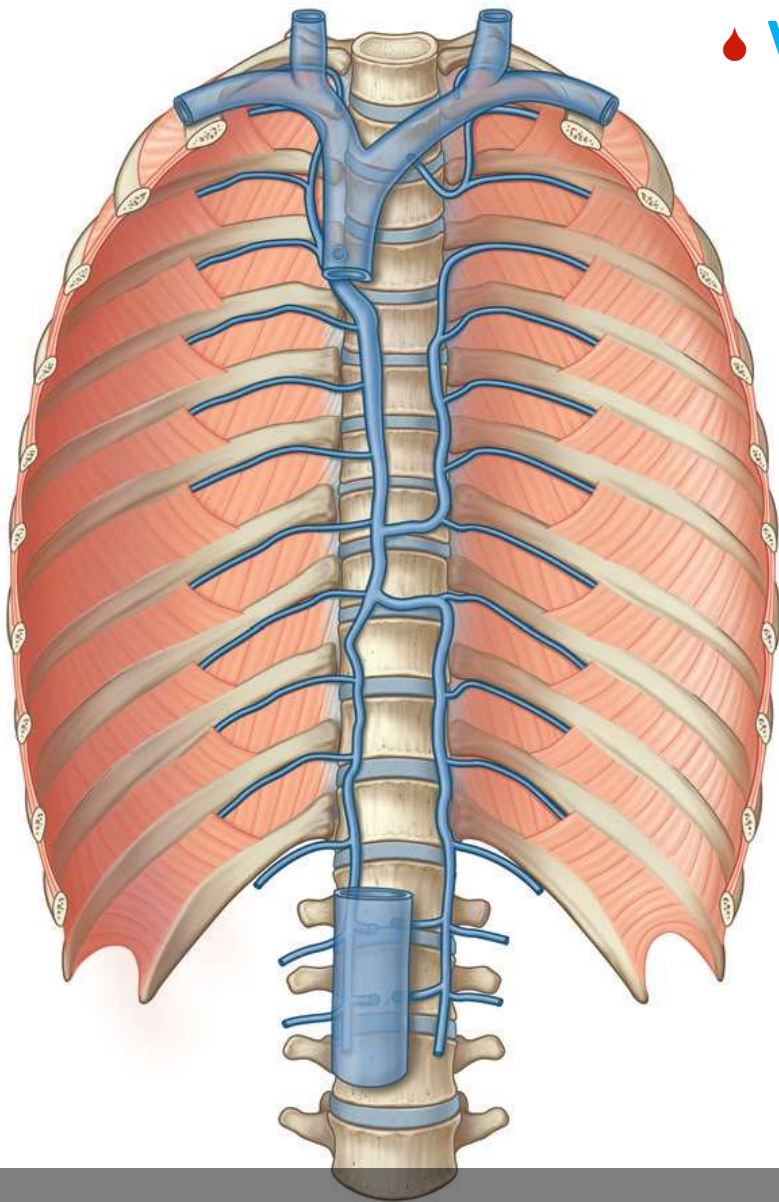
- **Left sided superior vena cava**
 - To sinus coronarius
 - Typical in doubled superior vena cava

ANATOMIC VARIANTS



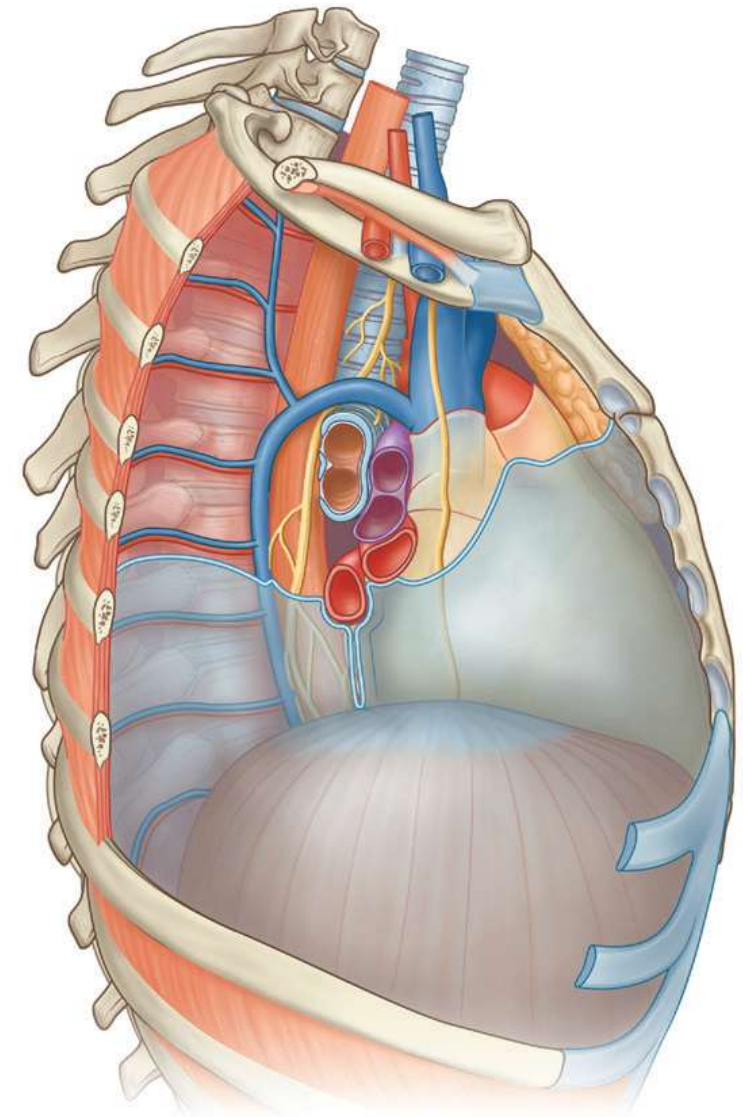
- ♦ V. brachiocephalica dextra
- ♦ V. brachiocephalica sinistra
- ♦ V. thoracica interna
- ♦ V. intercostalis superior (suprema)
- ♦ V. thyroidea inferior (ima)

UPEPR MEDIASTINUM VEINS

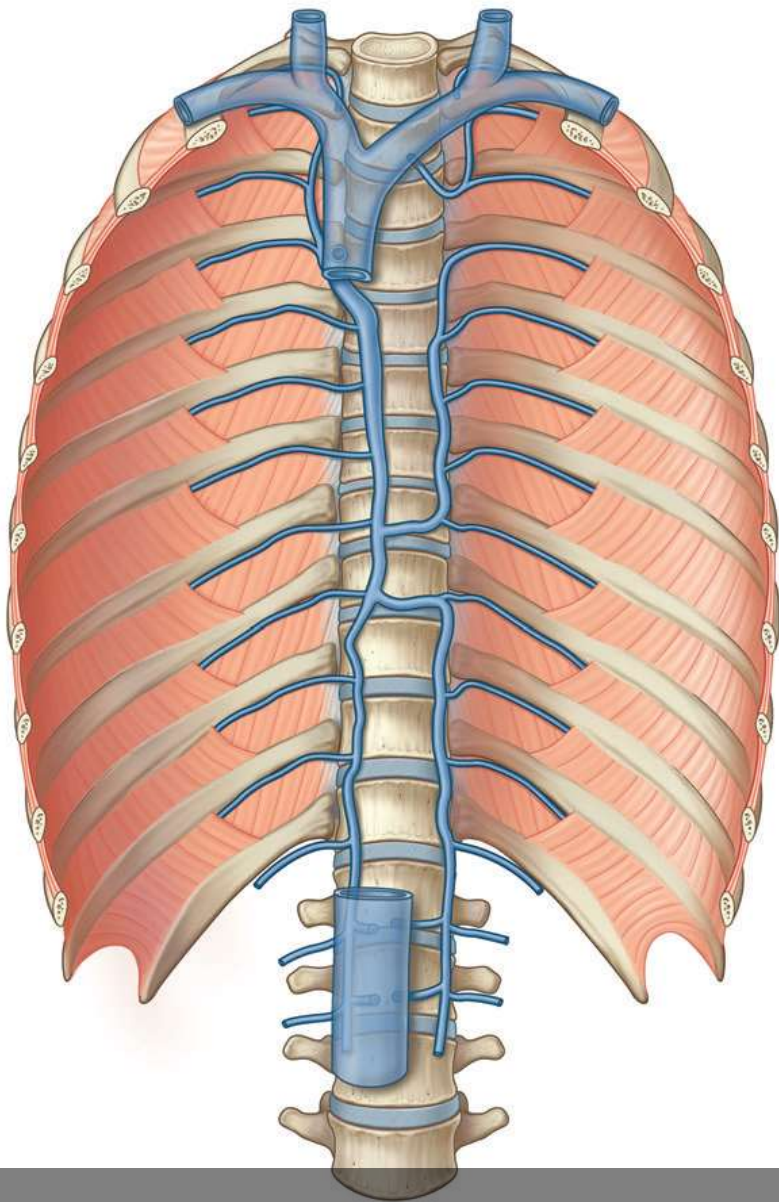


♦ V. azygos

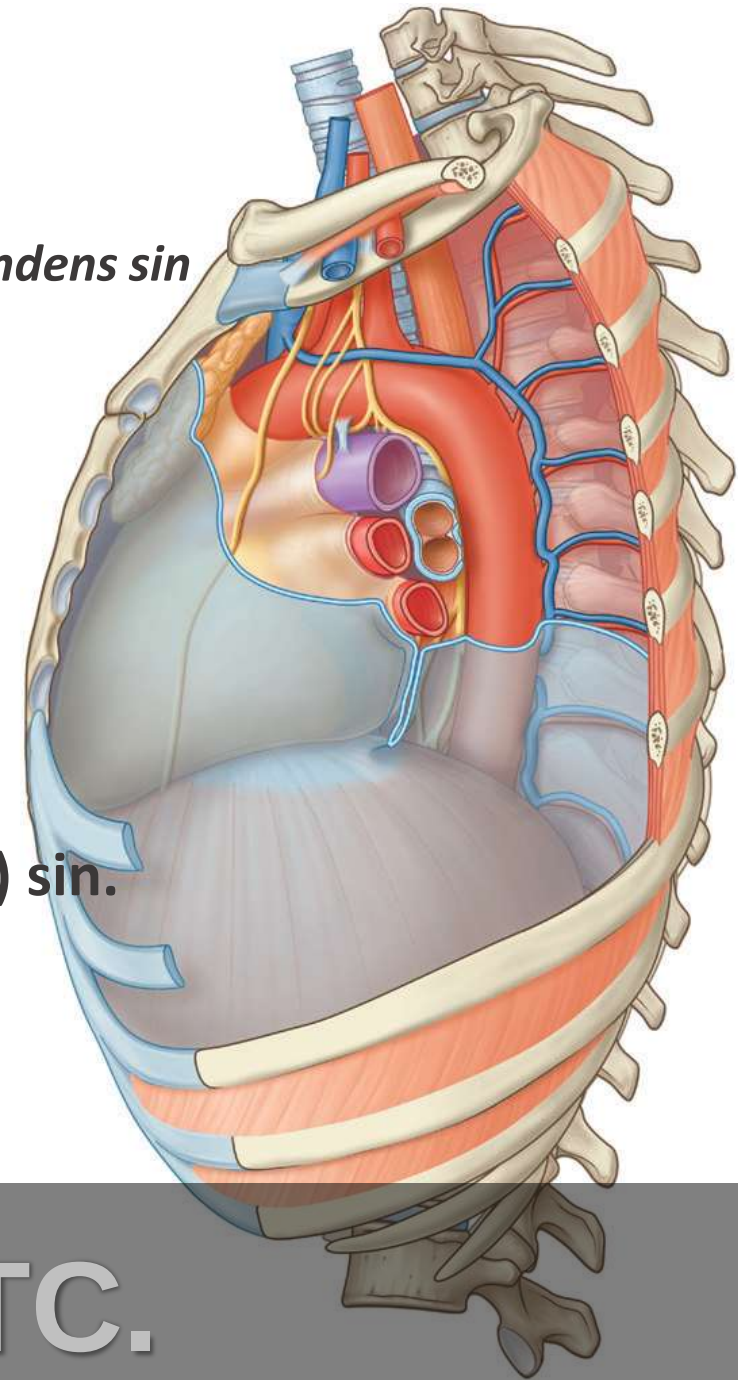
- ♦ Right prevertebral
- ♦ confluens
- ♦ *v. subcostalis dx.*
- ♦ *v. lumbalis ascendens dx.*
- ♦ **to v. cava superior in level Th4**
 - ♦ Bowing anteriorly
 - ♦ Superior to hilus
 - ♦ Over the origin of pericardium
- ♦ **branches**
 - ♦ *Vv. intercostales dx (5. - 11.)*
 - ♦ *V. intercostalis superior*
 - ♦ *V. hemiazygos*
 - ♦ *V. hemiazygos accesoria*
 - ♦ *Vv. oesophageales, mediastinales, pericardiales, bronchiales (dx)*



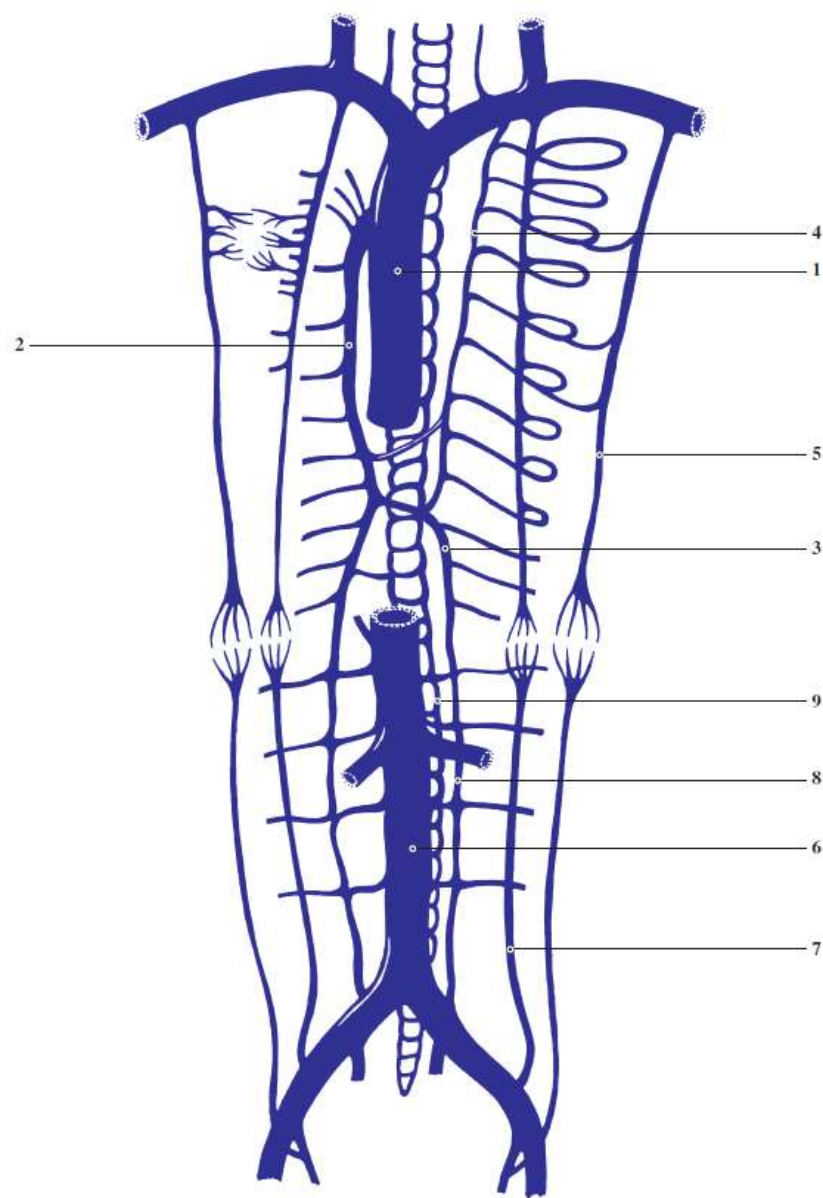
V. AZYGOS



- ♦ **V. hemiazygos**
 - ♦ Prevertebral left
 - ♦ Confluens of
 - ♦ *v. subcostalis sin. a v. lumbalis ascendens sin*
 - ♦ To v. azygos
 - ♦ In level of Th9 going to right
- ♦ **V. hemiazygos accesoria**
 - ♦ Prevertebral left
 - ♦ Intakes of intercostal veins
 - ♦ To v. azygos in
 - ♦ Th7/8 going to right
- ♦ **V. intercostalis superior (suprema) sin.**
 - ♦ variable going to
 - ♦ V. hemiazygos
 - ♦ V. brachiocephalica sin.



V. HEMIAZYGOS ETC.



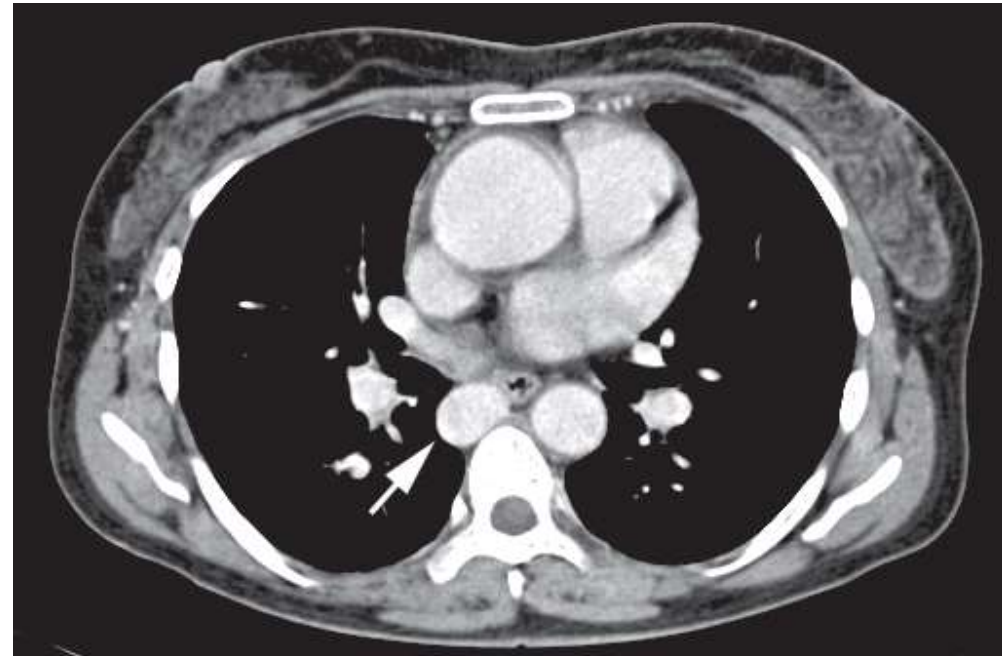
♦ V. lumbalis ascendens

♦ Continuation syndrome

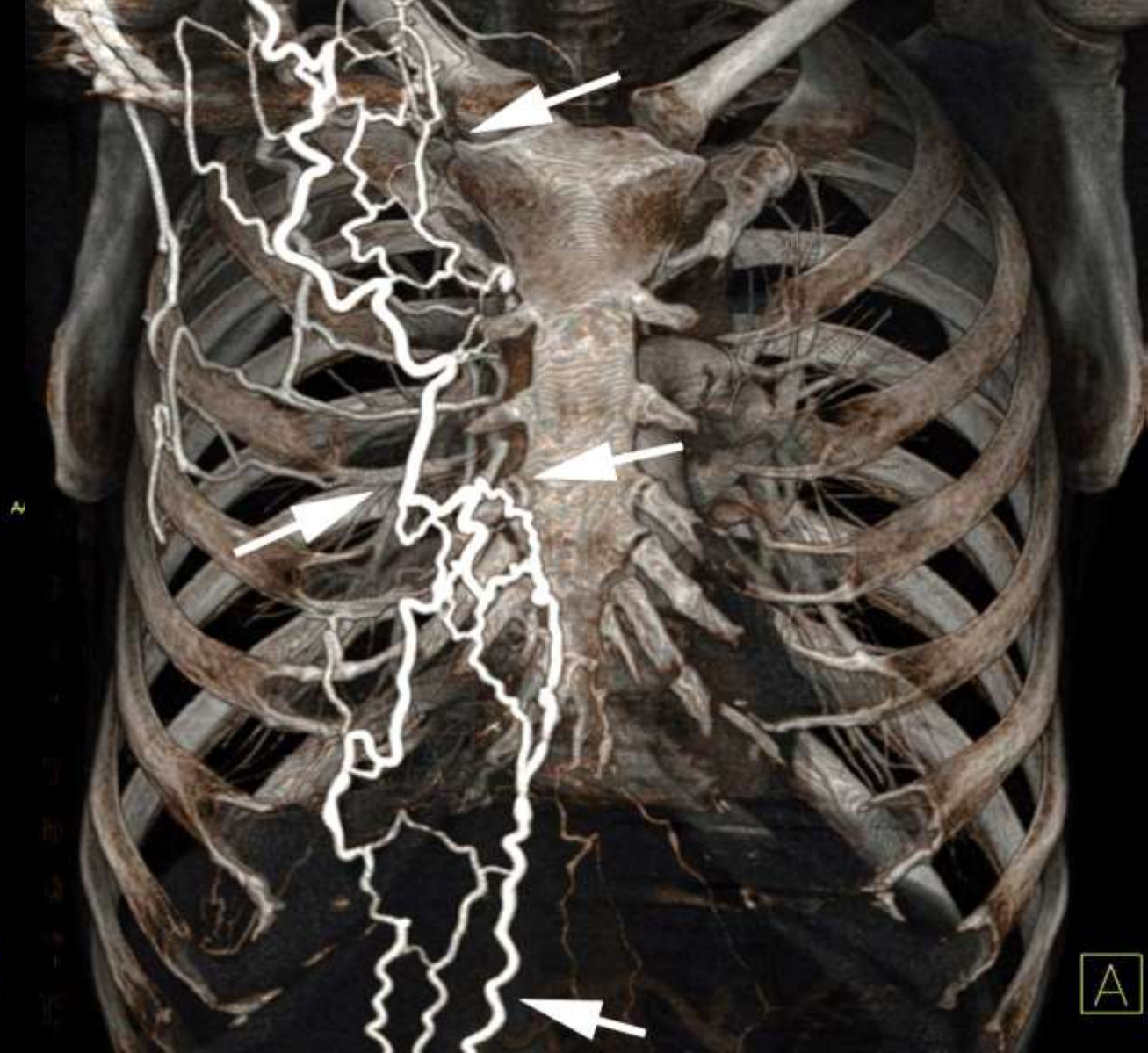
♦ Inferior vena cava follows as

♦ V. azygos - inferior vena cava is not connected to liver

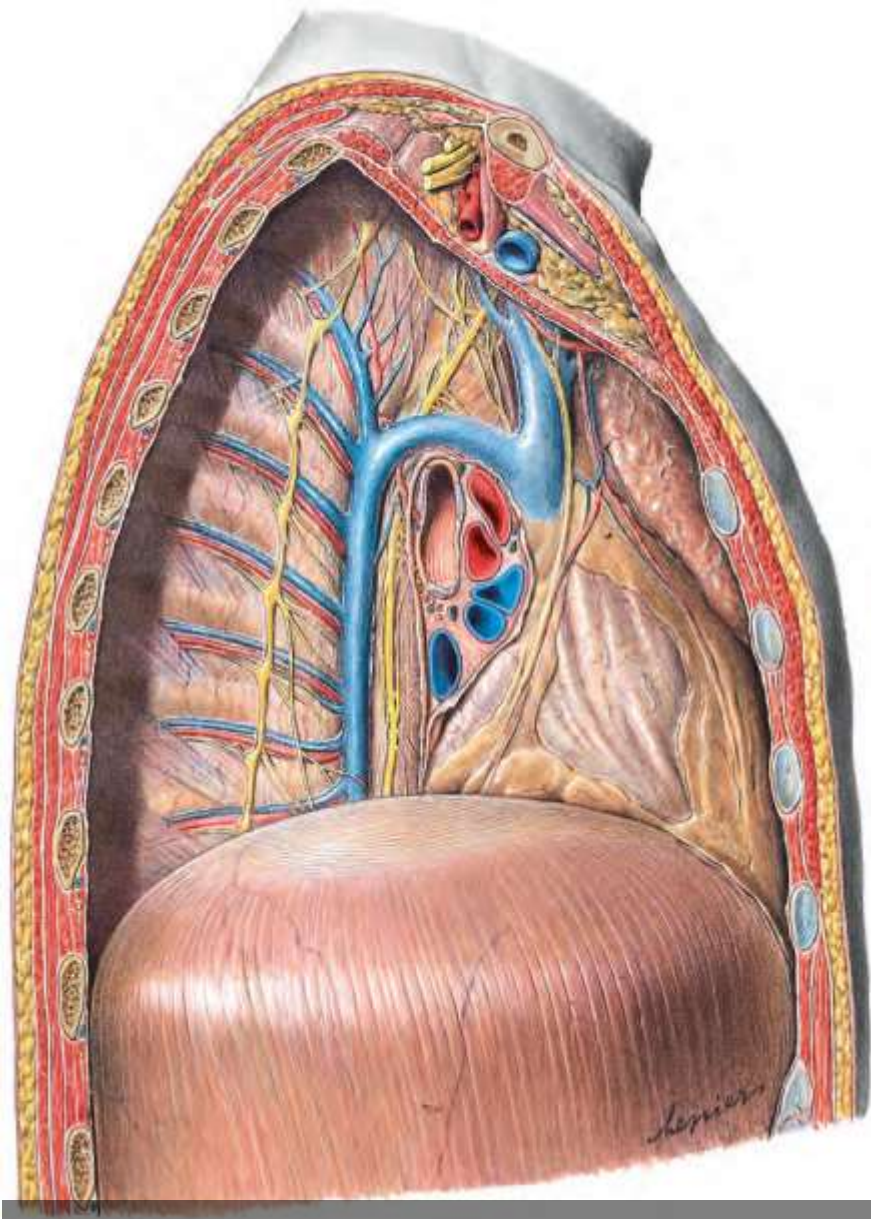
♦ V. hemiazygos – left sided inferior vena cava



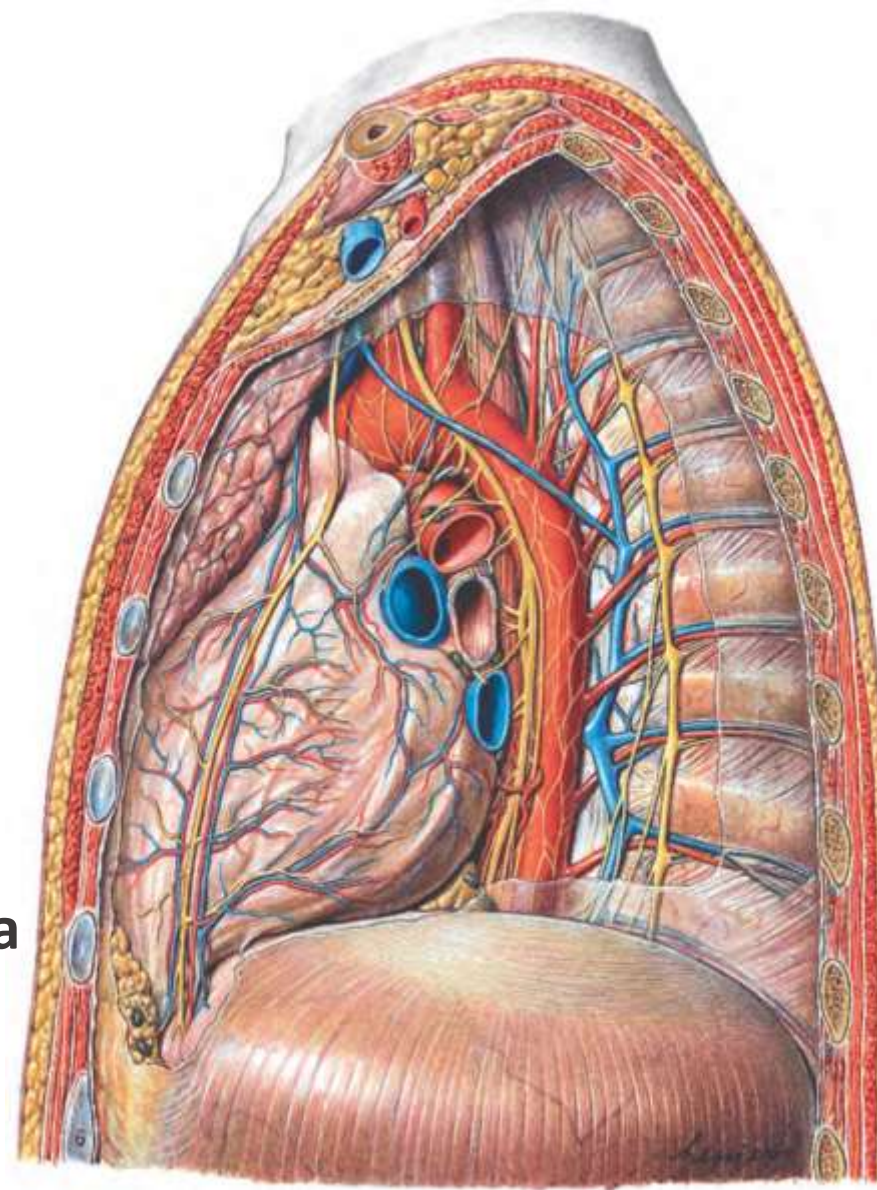
VENOUS CONNECTION OF RETROP.



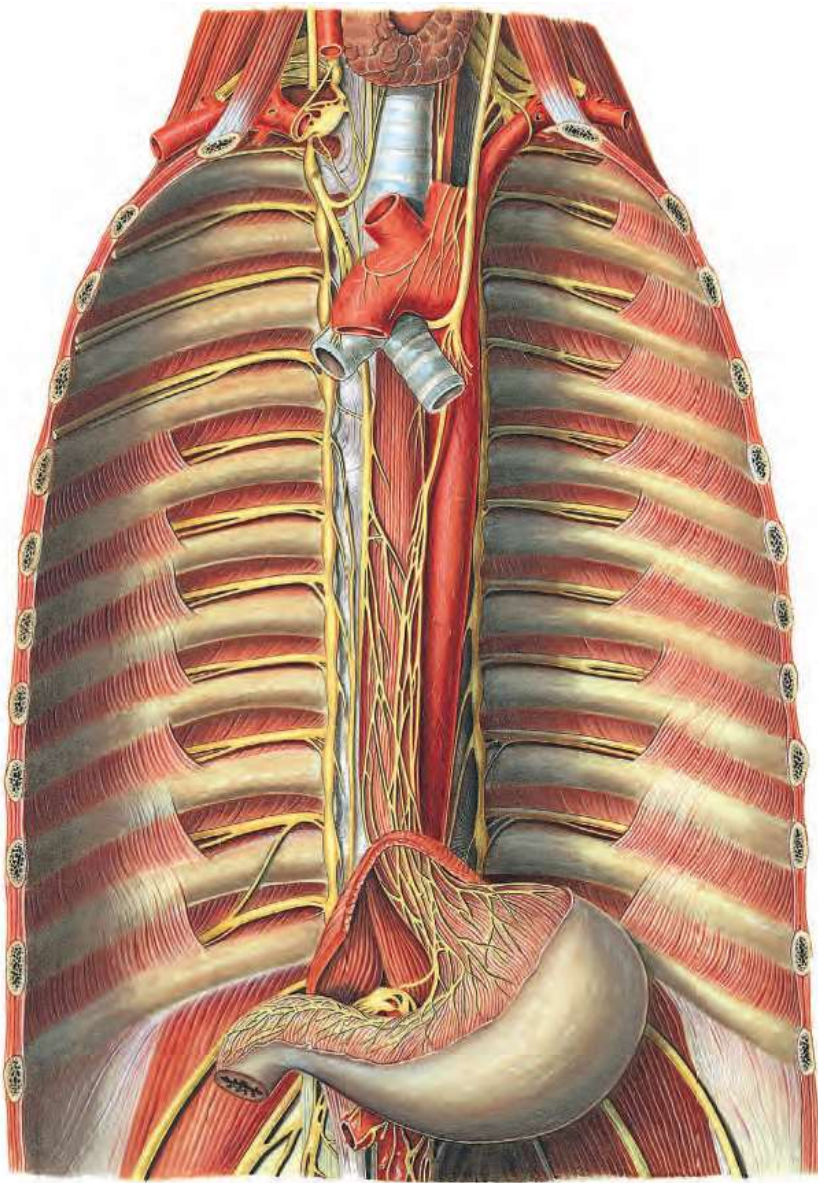
SUPERIOR VENA CAVA SYNDROME



- ♦ Truncus sympathicus
- ♦ Nervus vagus (n. X)
- ♦ Nervus phrenicus
- ♦ Nn. intercostales
- ♦ Aorta
- ♦ Vena cava superior
- ♦ Vena brachiocephalica
- ♦ V. azygos
- ♦ V. hemiazygos
- ♦ V. intercostalis suprema
- ♦ Vasa intercostalia
- ♦ Vasa thoracica interna



VEINS AND NERVES



♦ Truncus sympathicus

♦ Ganglia sympathica

- ♦ Oesophagus, heart, bronchi, lungs

♦ Nervus splanchnicus major (5. - 9. event. 10. sympat. ganglion)

- ♦ *Greater splanchnic nerve (engl.)* – ganglia coeliaca

♦ Nervus splanchnicus minor (9. - 11. sympat. ganglion)

- ♦ *Lesser splanchnic nerve (engl.)* – ganglia aorticorenalia

♦ Nervus splanchnicus minimus (12. sympat. ganglion)

- ♦ *Least splanchnic nerve (engl.)* – plexus renalis

♦ Nervi cardiaci

♦ Nervus vagus (n. X)

- ♦ Rami to bronchi and lungs

- ♦ Rami to heart

- ♦ Plexus oesophagealis

- ♦ Truncus vagalis anterior (n. vagus sinister)

- ♦ Truncus vagalis superior (n. vagus dexter)

AUTONOMOUS NERVES

Thorax

Prof. MUDr. Jiří Ferda, Ph.D.