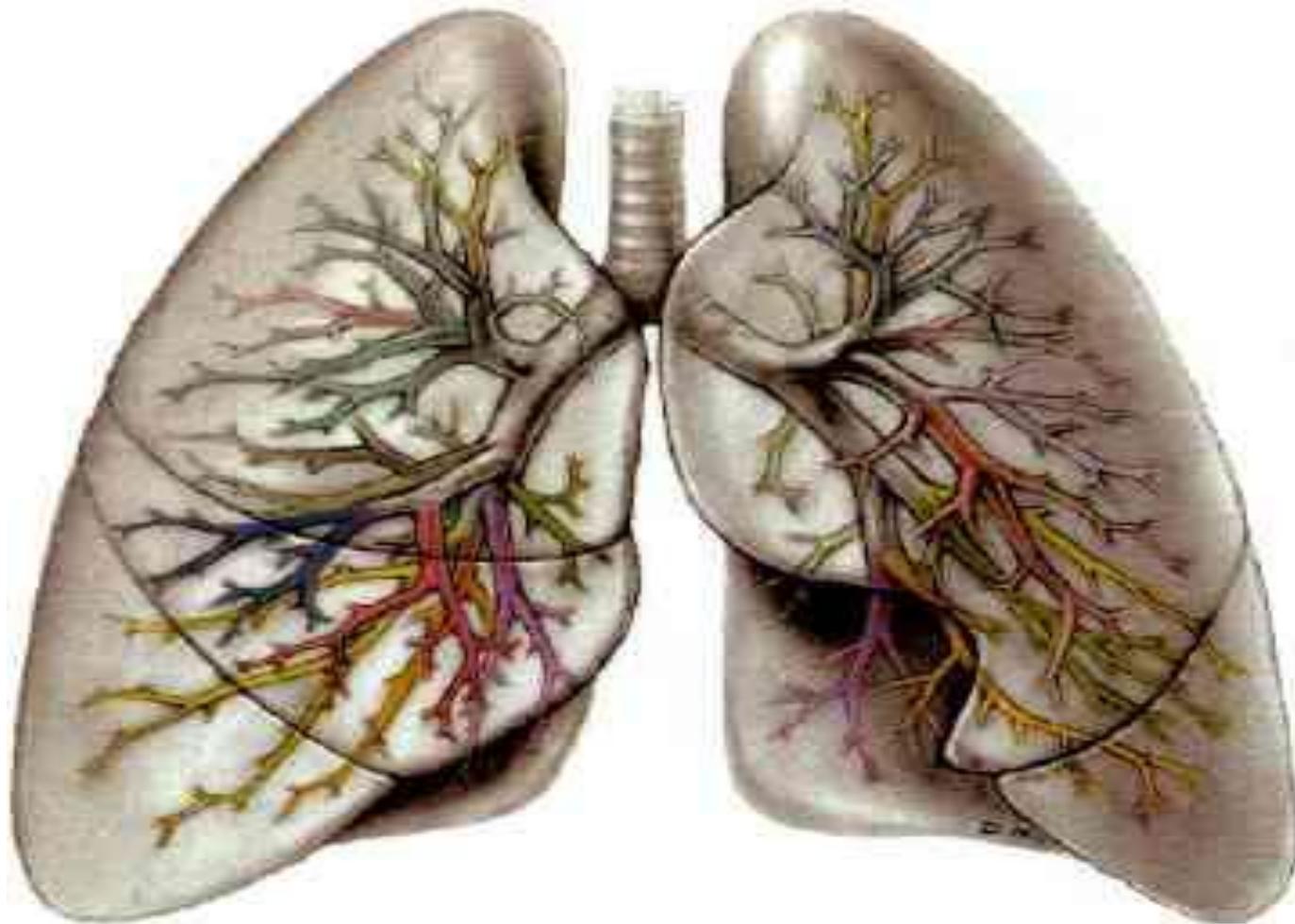


SISTEMA RESPIRATORIUS



dr. Al-Muqsith, M.Si

SISTEM PERNAFASAN

- Pernapasan: Pertukaran oksigen (O_2) & karbondioksida (CO_2) antara makhluk hidup & lingkungannya
- Proses pembakaran zat makanan (Oksidasi Biologis):

Zat makanan + Oksigen \rightarrow Karbondioksida + Uap air + Energi
[(gula/ $C_6H_{12}O_6$) + (O_2) \rightarrow (CO_2) + (H_2O) + (E)]

- Proses Pernapasan

a. Pernapasan eksternal

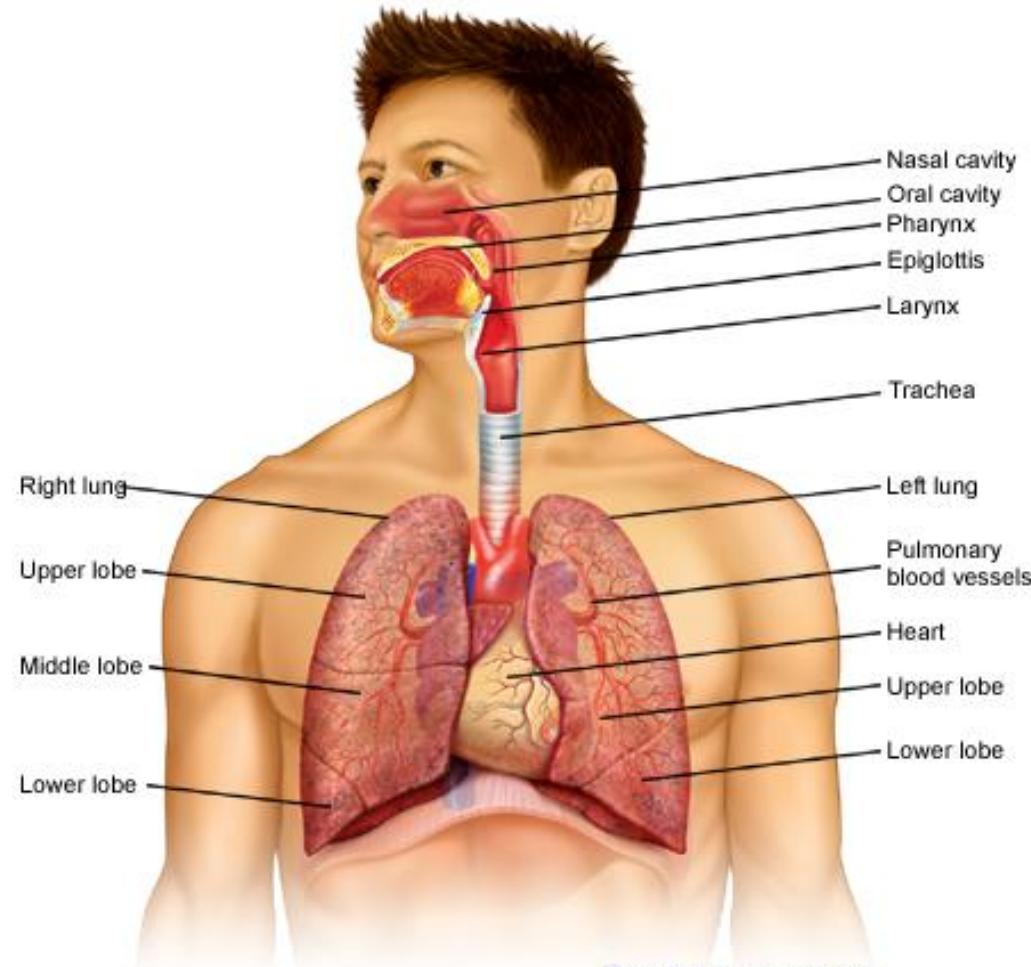
Pertukaran O_2 & CO_2 antara udara dlm alveolus dgn darah dlm kapiler

b. Pernapasan internal

Pertukaran O_2 & CO_2 antara darah dlm kapiler dgn sel-sel jaringan tubuh

TRACTUS RESPIRATORIUS

- Nasal
- Pharyng
- Laryng
- Trachea
- Bronchus
- Bronchiolus
- Pulmo

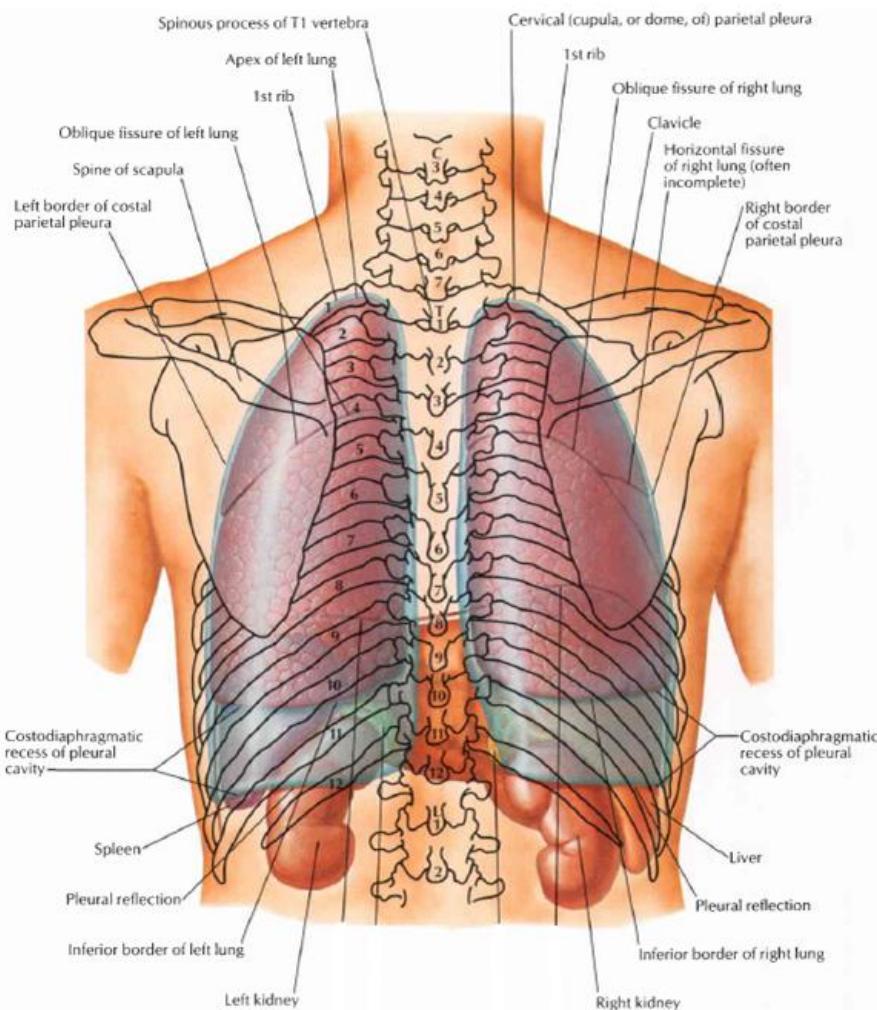
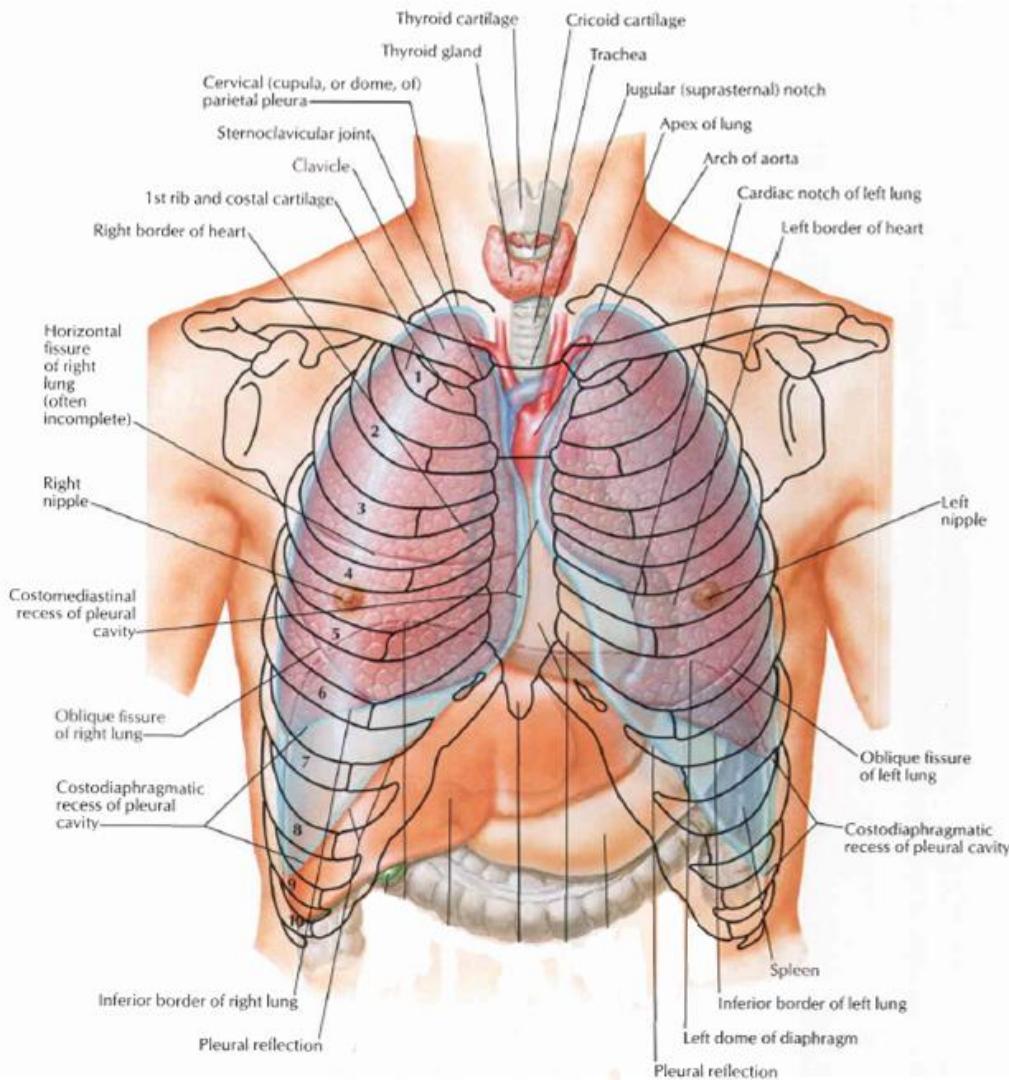


TULANG PEMBENTUK CAVUM THORAX

- Os. Costae (12 pasang)
- Os. Vertebra thoracalis (12 buah)
- Os. Sternum (1 buah)
- Os. Clavicula (2 buah)
- Os. Scapula (2 buah)

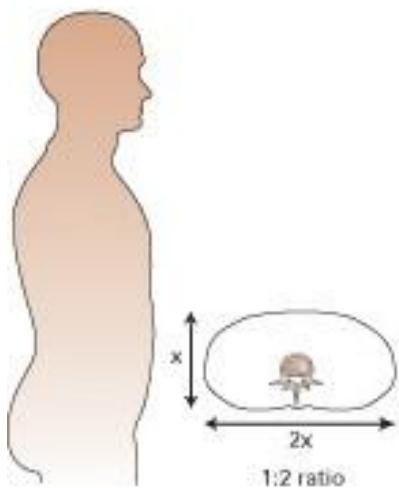
OTOT PEMBATAS CAVUM THORAKS

- ◉ Otot ekstremitas sup.
 - M. Pectoralis mayor
 - M. Pectoralis minor
 - M. Serratus anterior
 - M. Subclavius
- ◉ Otot anterolateral abdominal
 - M. Obliquus externus abdominis
 - M. Rectus abdominis
- ◉ Otot thoraks intrinsik
 - M. Intercostalis externa
 - M. Intercostalis interna
 - M. Sternalis
 - M. Transversus thoracis

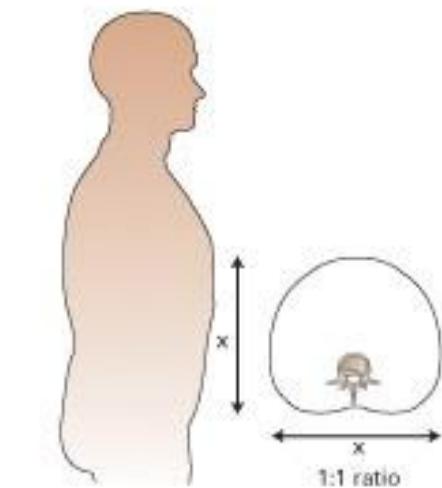


BENTUK THORAKS

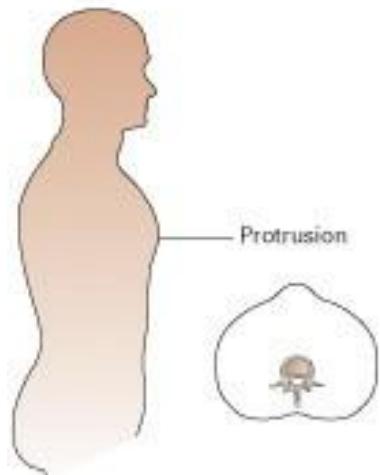
A. Normal Adult



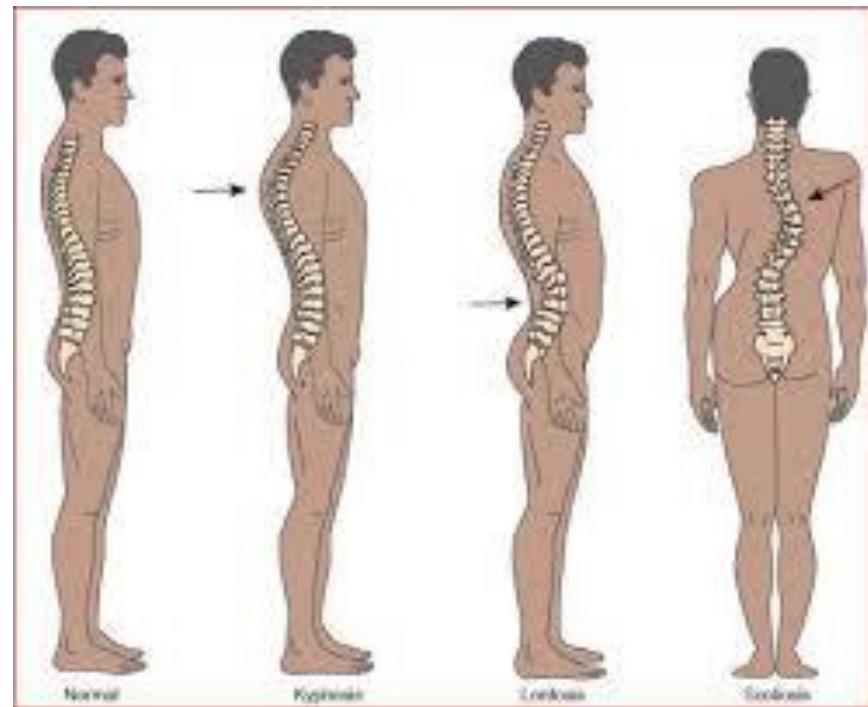
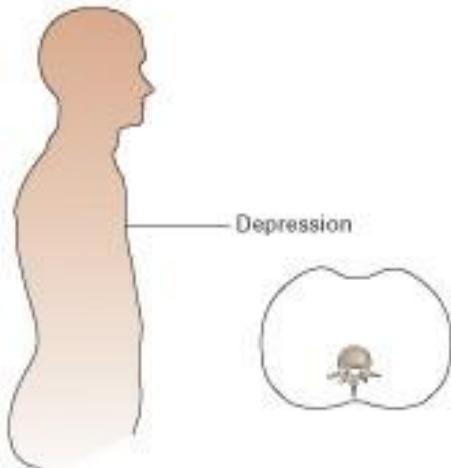
B. Barrel Chest



C. Pectus Carinatum



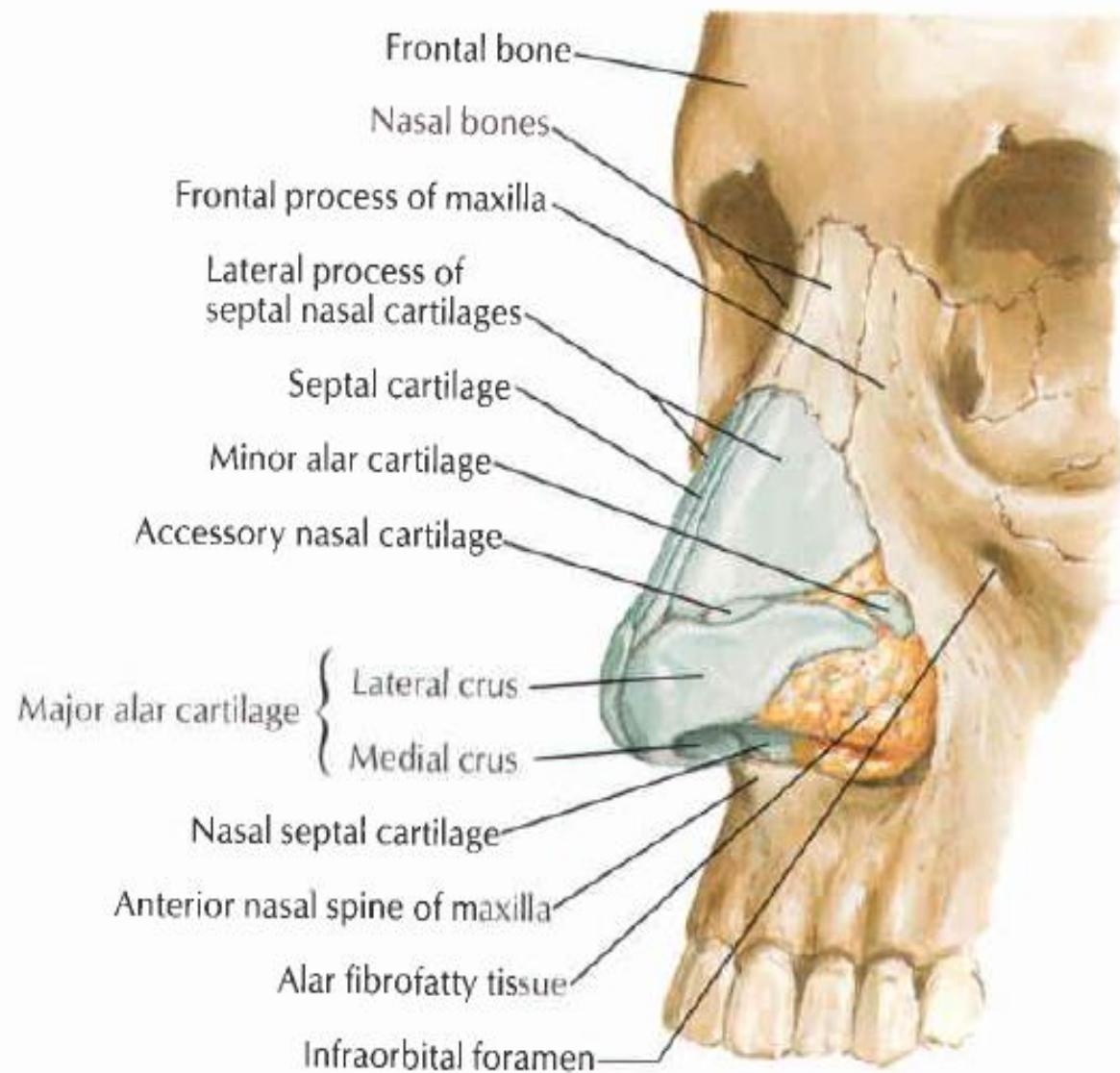
D. Pectus Excavatum



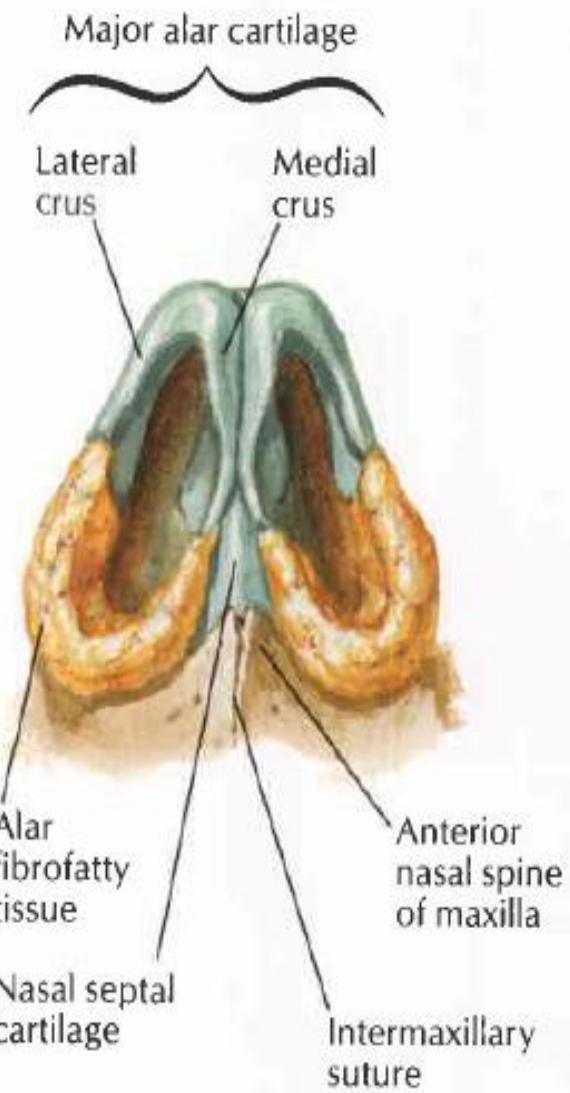
NASAL (eksterna)

- Bagian hidung luar :
 - a. Bridge (pangkal hidung)
 - b. Dorsum nasi
 - c. Puncak hidung
 - d. Ala nasi
 - e. Nostril / nares anterior
- Hidung luar dibentuk oleh :
 - a. kerangka tulang
 - os nasalis
 - proc. Frontalis os maxilla
 - proc. Nasalis os frontal
 - b. Kerangka tulang rawan
 - kartilago nasalis lateralis superior (1 psg)
 - kartilago nasalis lateralis inferior/ala mayor (1 psg)
 - Kartilago ala minor (bbrp psg)
 - tepi anterior kartilago septum

Anterolateral view



Inferior view



NASAL (interna)

Hidung bagian dalam (cavum nasi) :

-terletak mulai dari nostril hingga choana

-Vestibulum

* bagian paling anterior & paling lebar dr rongga hidung

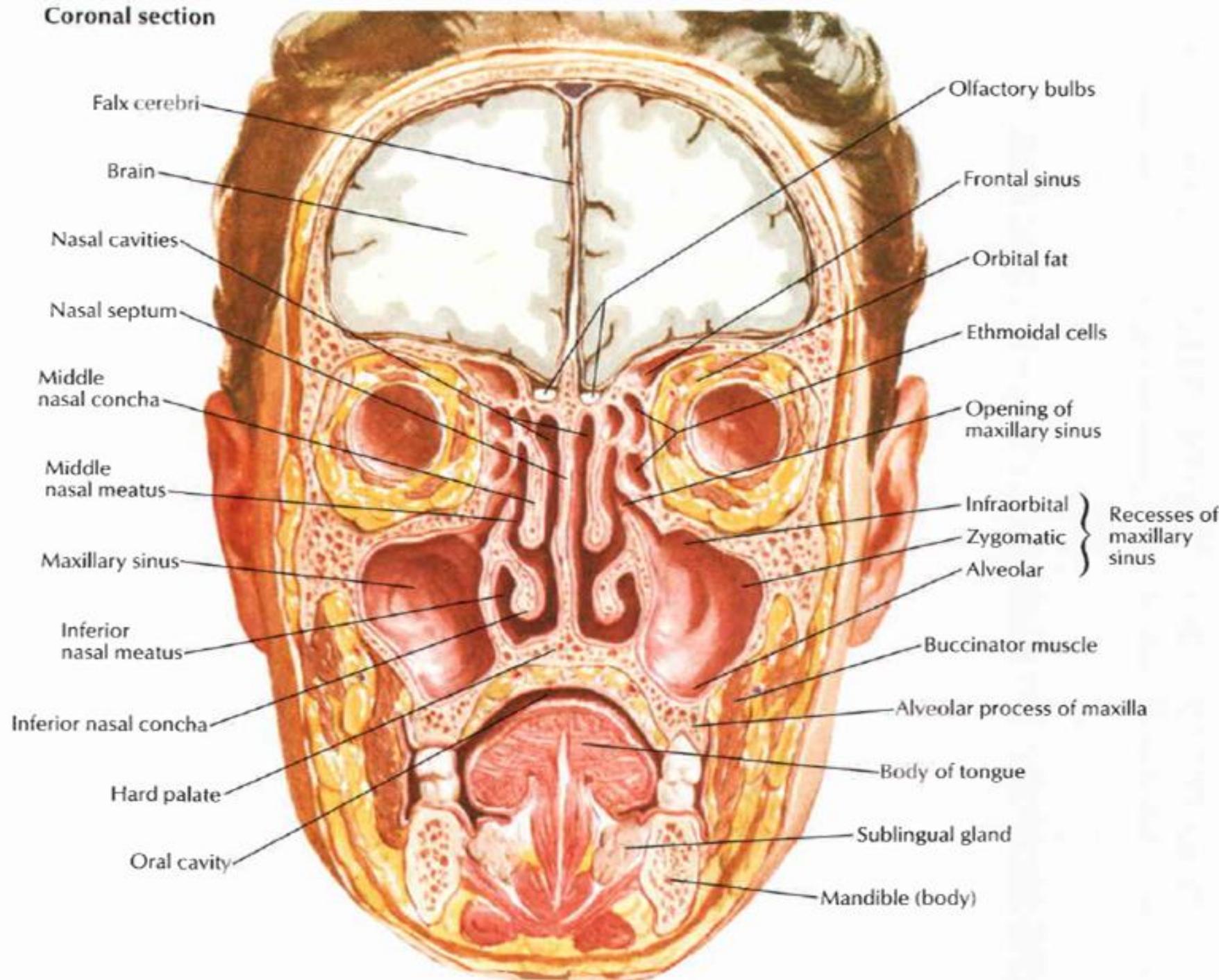
* terdapat banyak kelenjar sebacea, kelenjar keringat

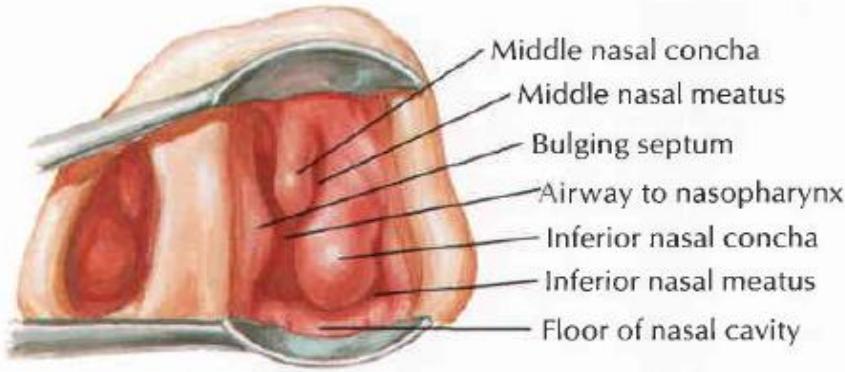
*vibrисae → menahan & menyaring partikel saat inspirasi

- Cavum nasi terdiri dari dinding medial, lateral, inferior, dan superior

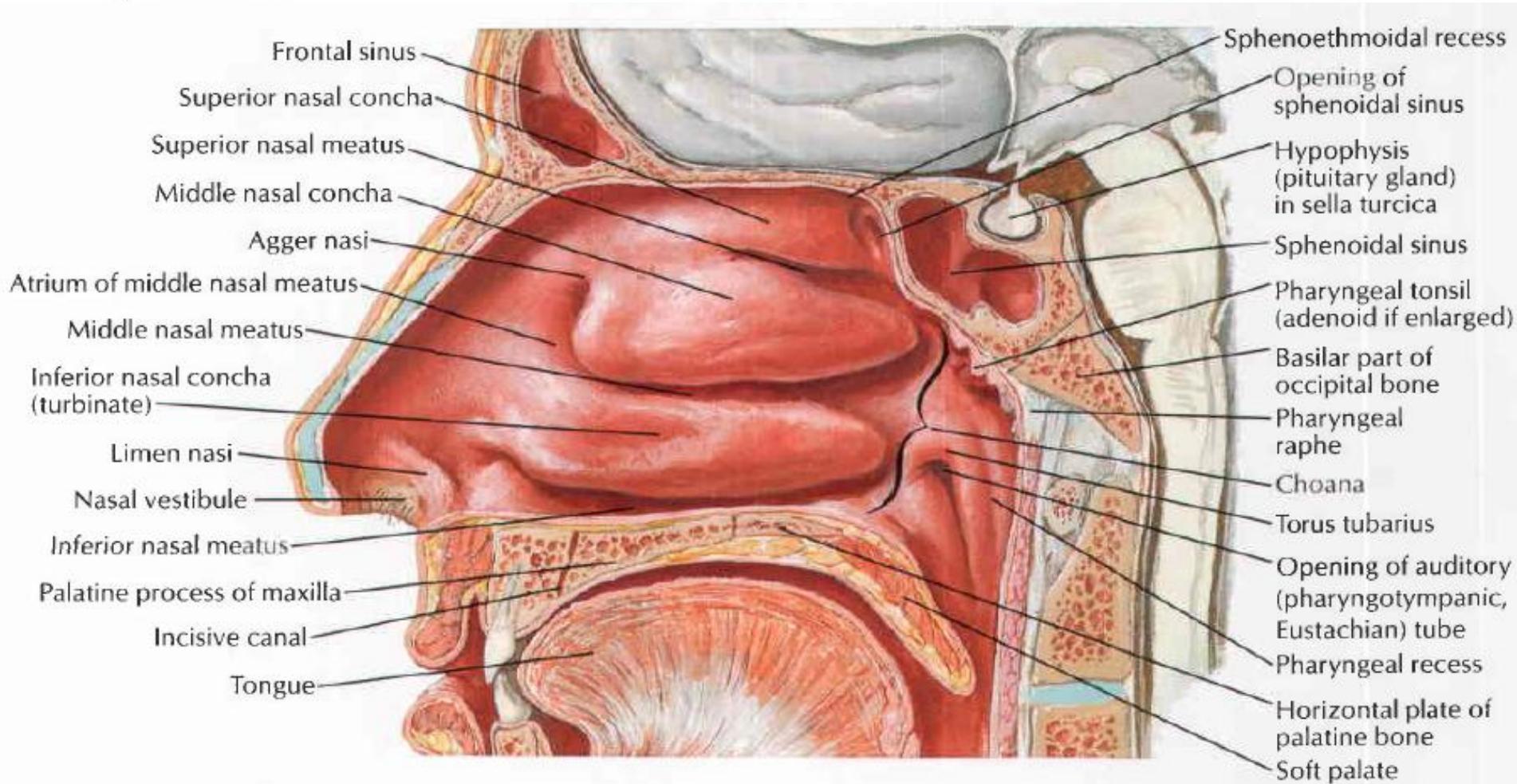
Dinding medial → septum nasi	antara concha dan dinding lateral hidung → meatus nasi	Dinding lateral → concha
- lamina perpendicularis os ethmoid	- meatus nasi superior	- concha nasalis suprema (rudimenter)
- os vomer	- meatus nasi media	- concha nasalis superior
- crista nasalis os maxilla	- meatus nasi inferior	- concha nasalis media
- crista nasalis os palatina		- concha nasalis inferior
- cartilago septum (lamina kuadrangularis)		
- kolumna		

Coronal section





Speculum view



Ethmoid sinuses

Superior nasal concha

Middle nasal concha

Inferior nasal concha

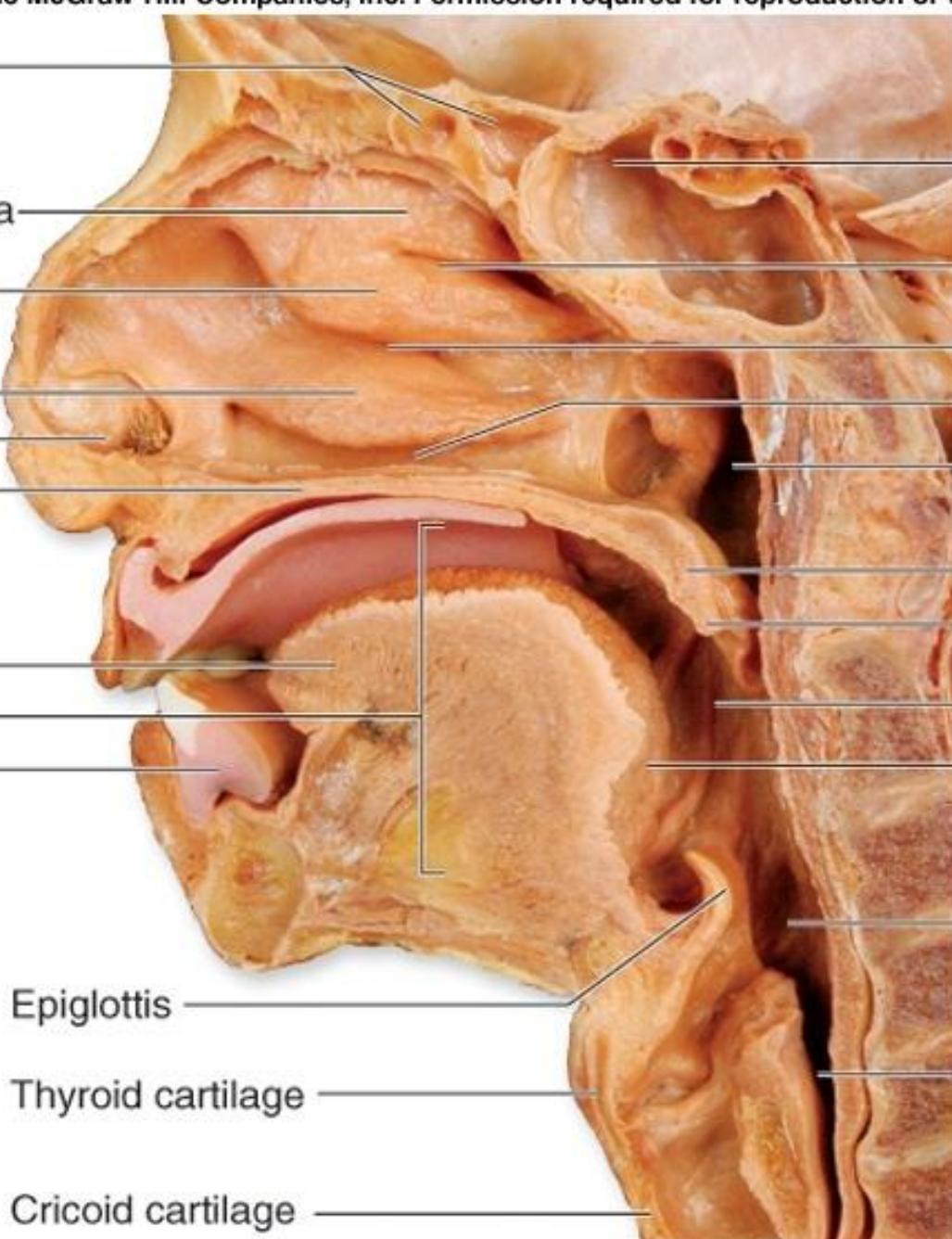
Vestibule

Hard palate

Tongue

Oral cavity

Dentures



Sphenoidal sinus

Superior meatus

Middle meatus

Inferior meatus

Nasopharynx

Soft palate

Uvula

Oropharynx

Lingual tonsil

Laryngopharynx

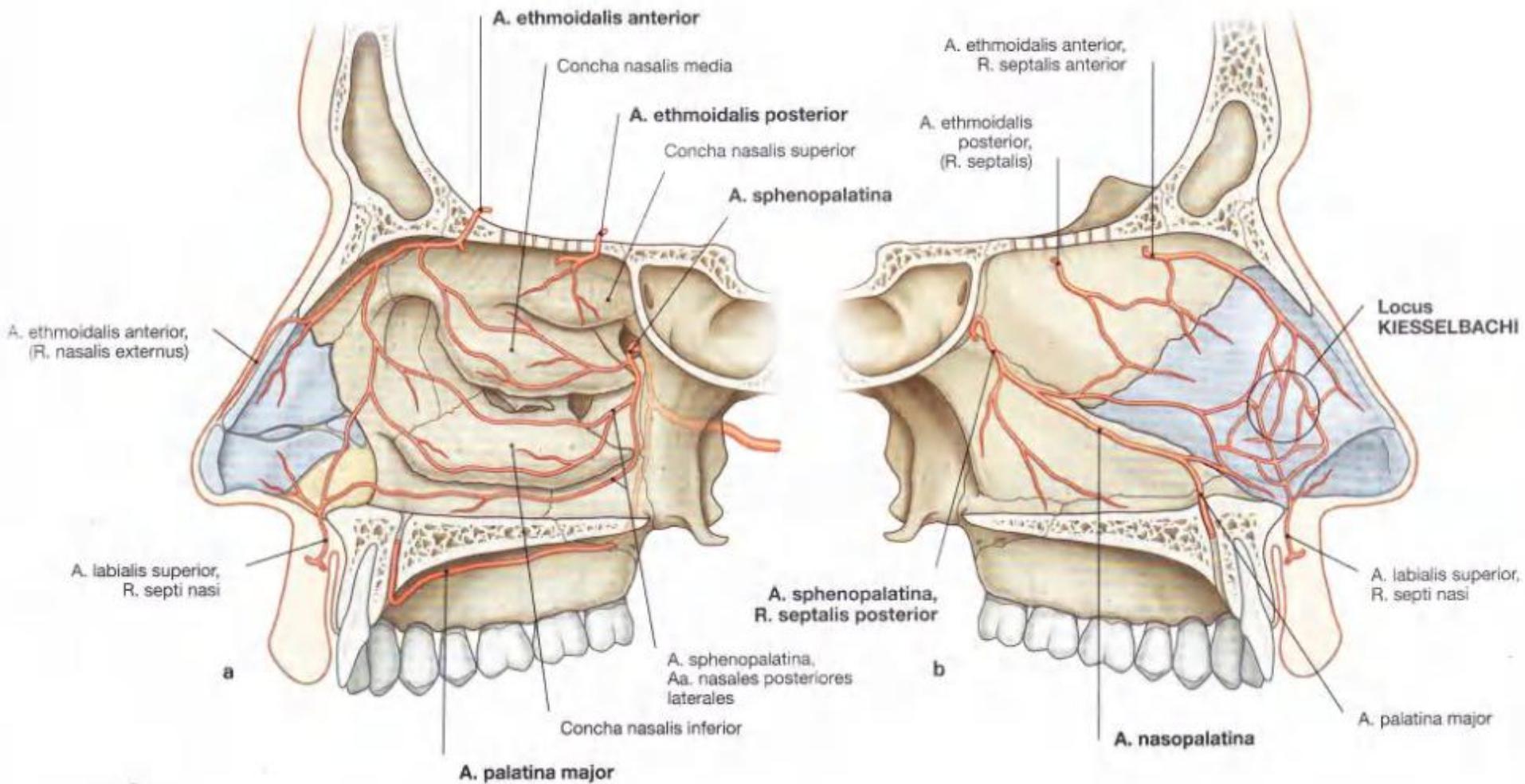
Esophagus

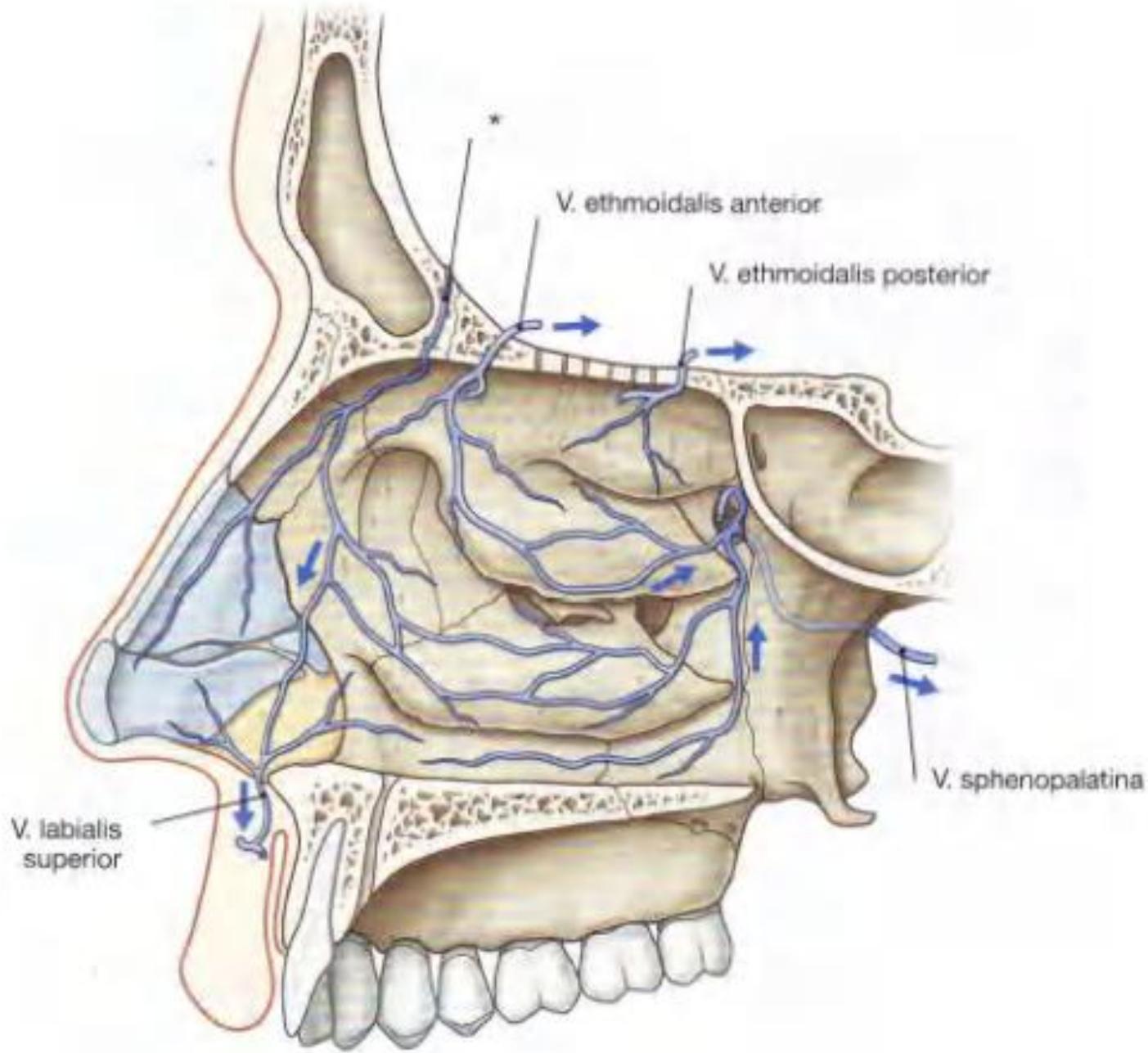
Vascularisasi Nasal

Arteri

- bagian bawah :
cabang a.maxillaris interna → a.palatina mayor dan
a. sphenopalatina
- bagian depan :
cabang a.facialis
- bagian depan septum : plexus kiesselbach (little's area)
→ a.palatina mayor, a.sphenopalatina, a.labialis sup. ,
a.ethmoid anterior

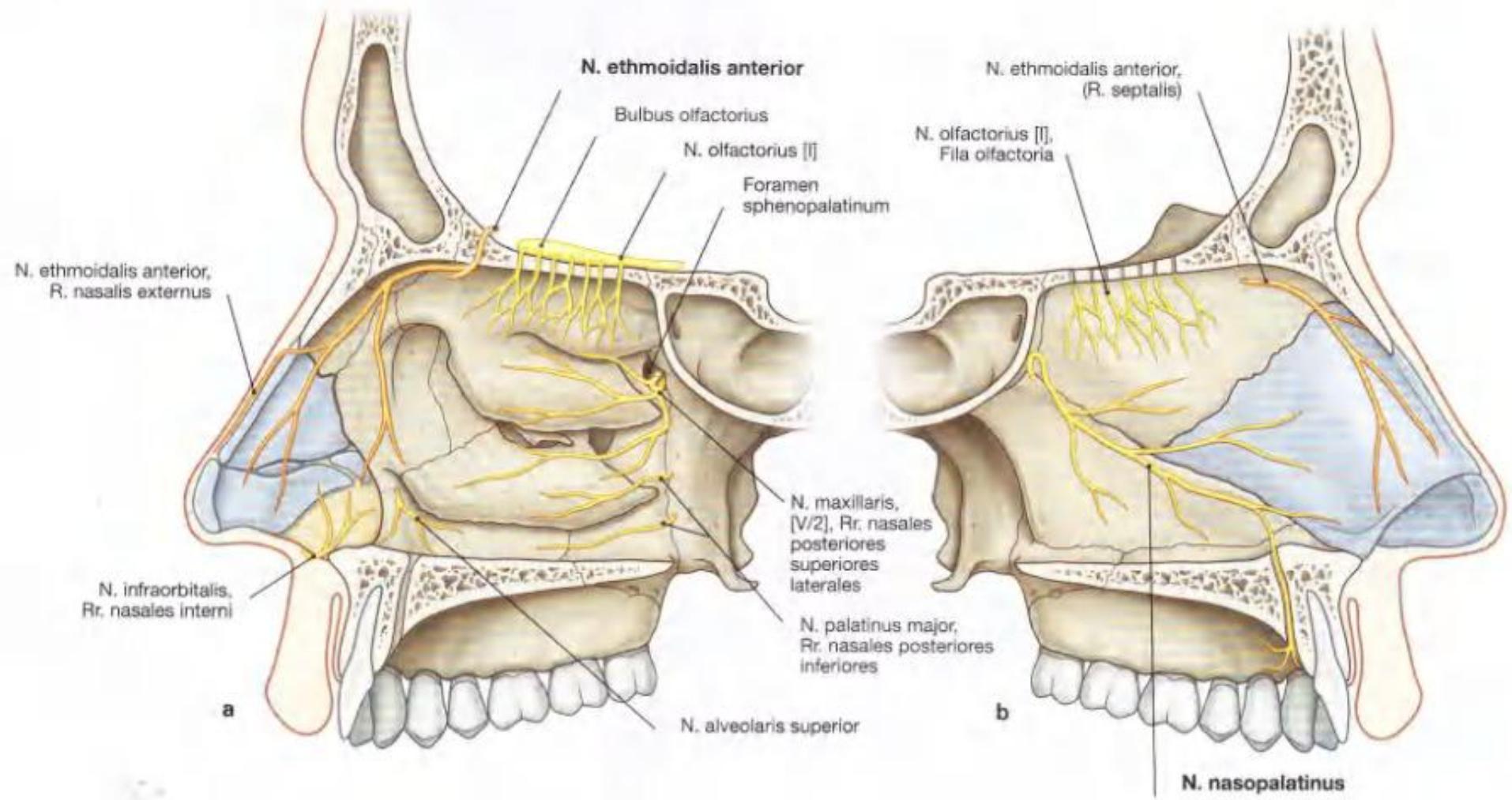
Vena → = arteri, berjalan berdampingan





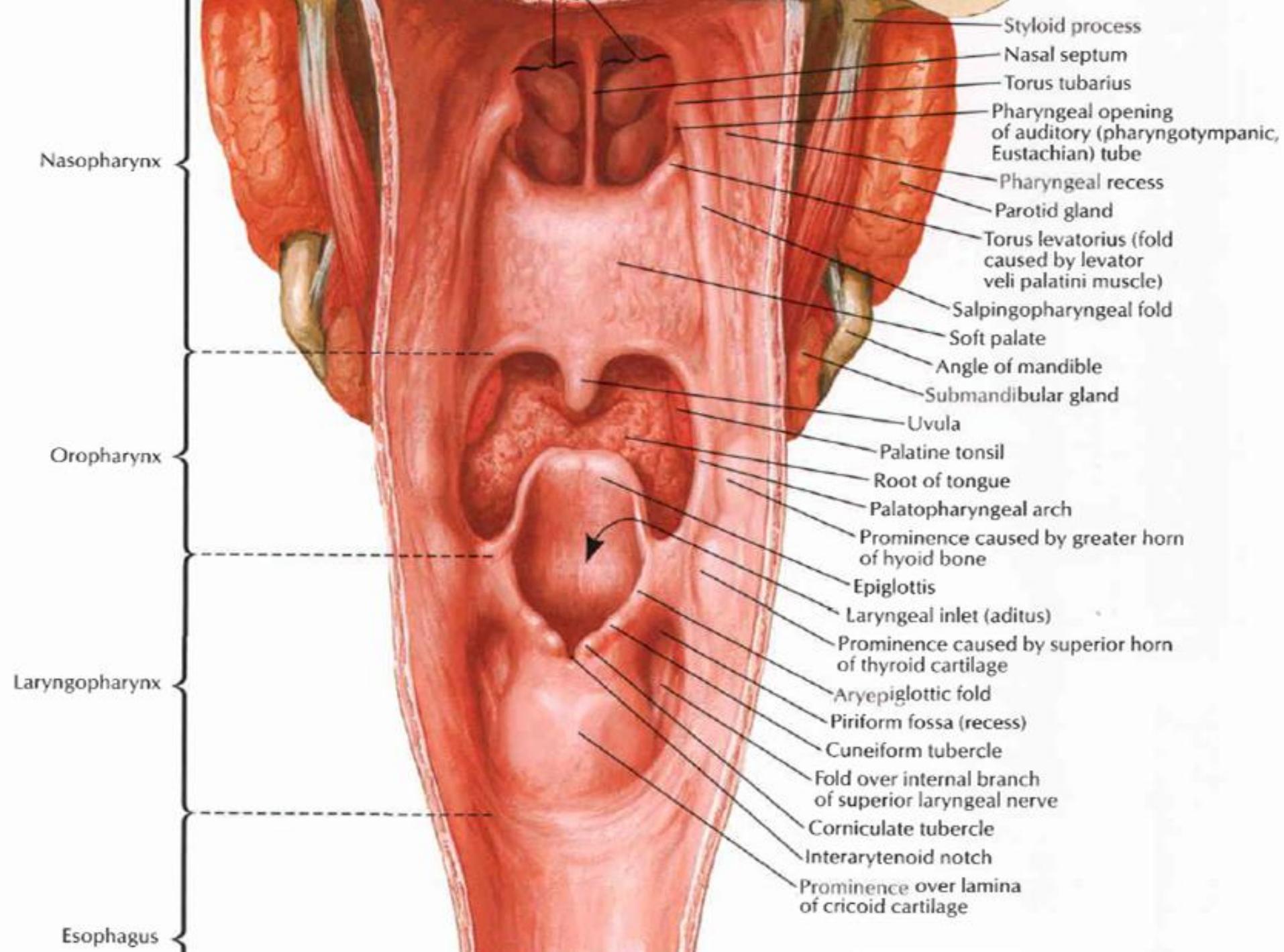
Innervasi Nasal

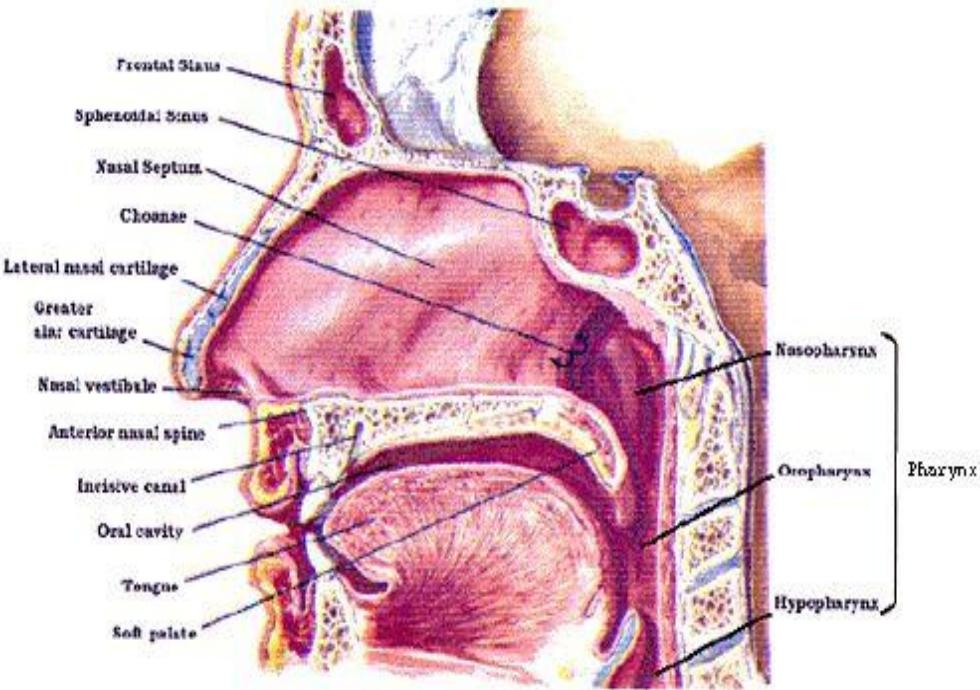
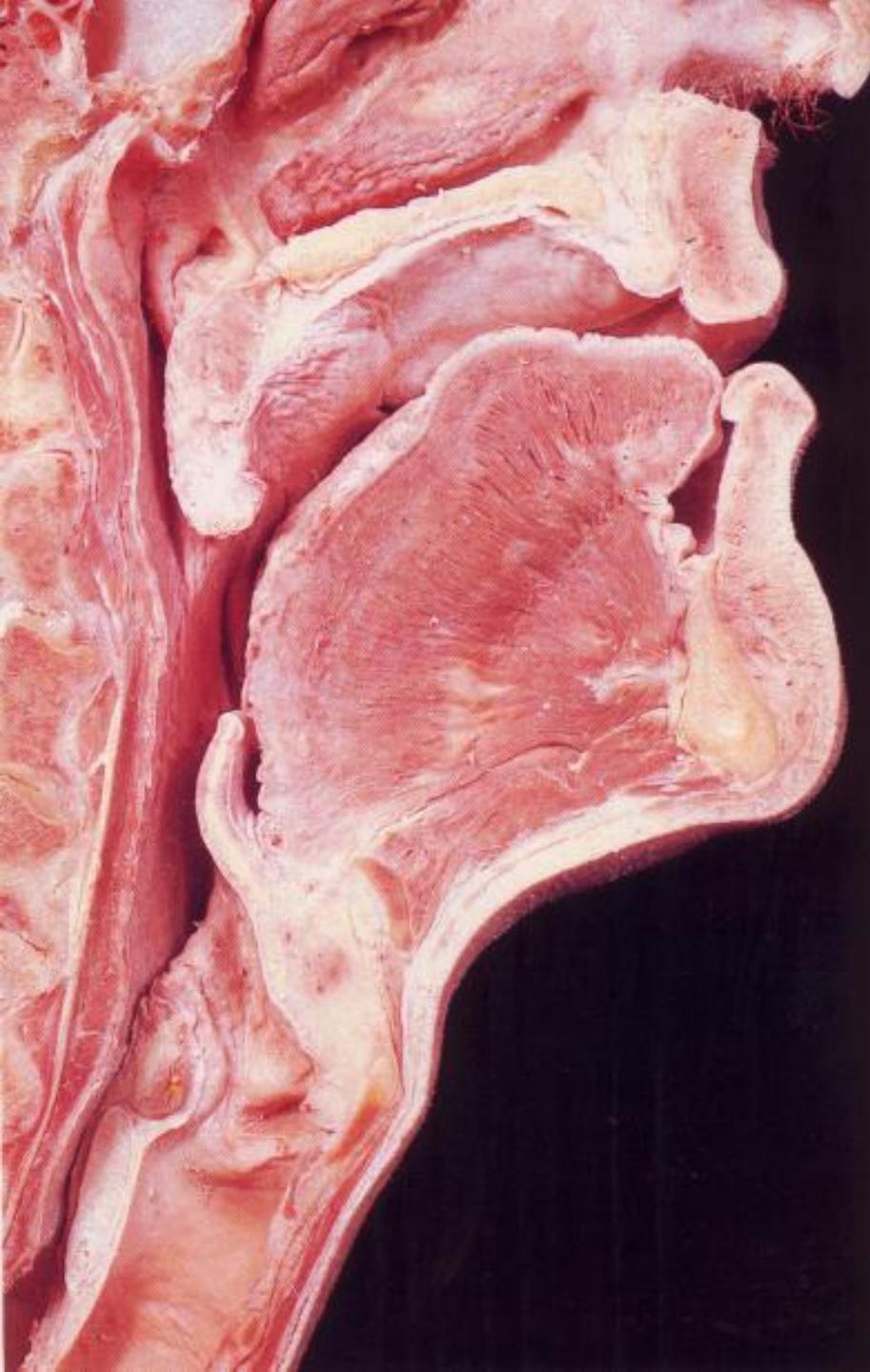
- Bagian depan dan atas cavum nasi (sensoris) → n.ethmoidalis anterior (n.nasosiliaris/n.opthalmica)
- Bagian hidung lainnya (sensoris) → Ggl.sphenopalatinum (n.maxilla)
- Mucosa cavum nasi (vasomotor/otonom)
→Ggl.sphenopalatinum, n. petrosus superficialis (parasimpatis), n. petrosus profunda (simpatis)
- Reseptor penghidu → n.olfactorius



PHARYNG

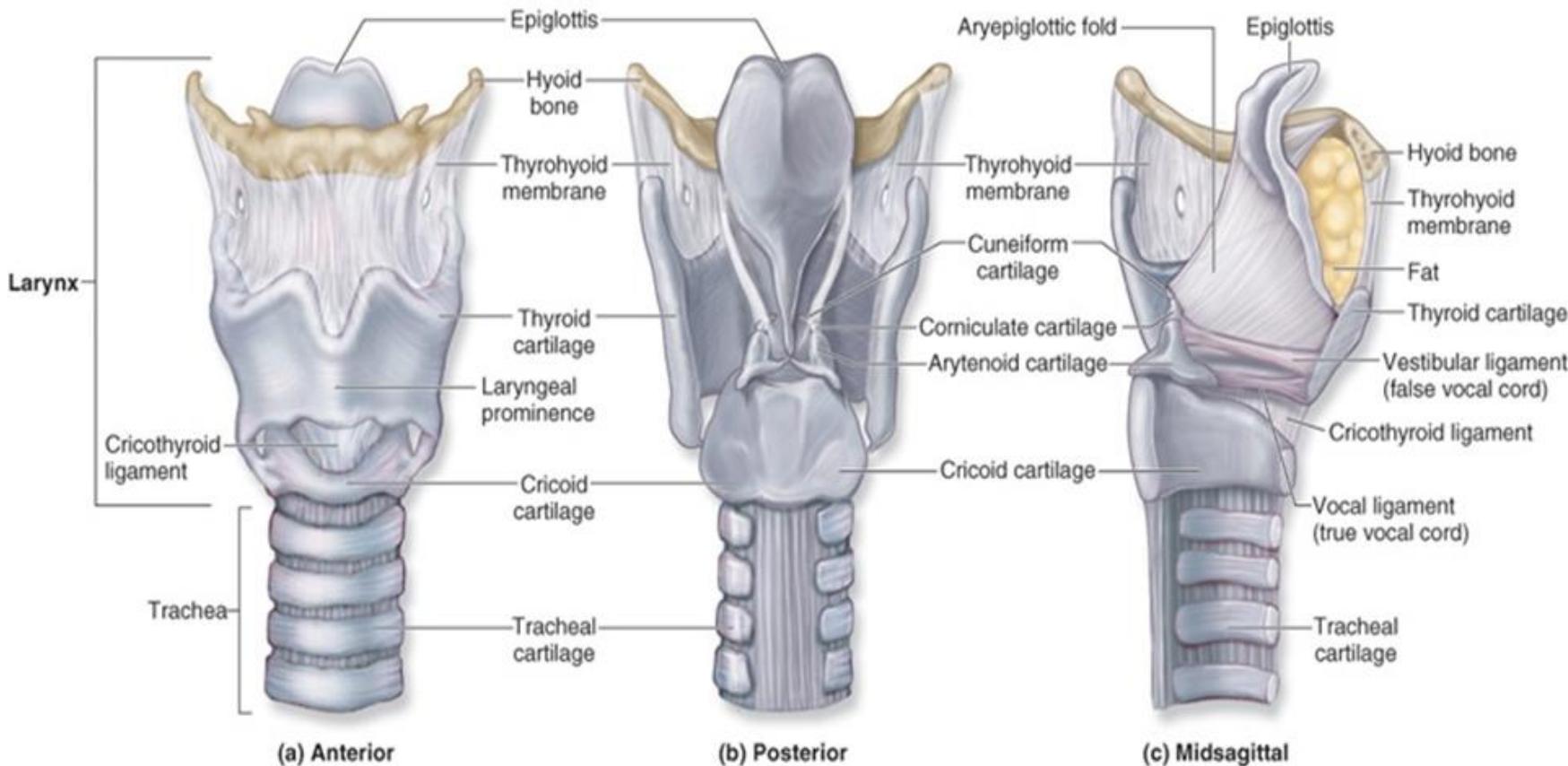
- ▶ Terdiri atas 3 bagian :
 - Nasopharyng (epipharyng)
 - Oropharyng (mesopharyng)
 - Laryngopharyng (hipopharyng)



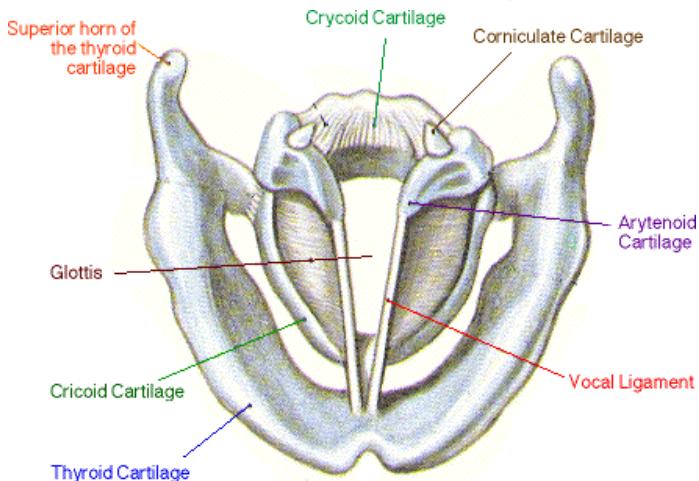


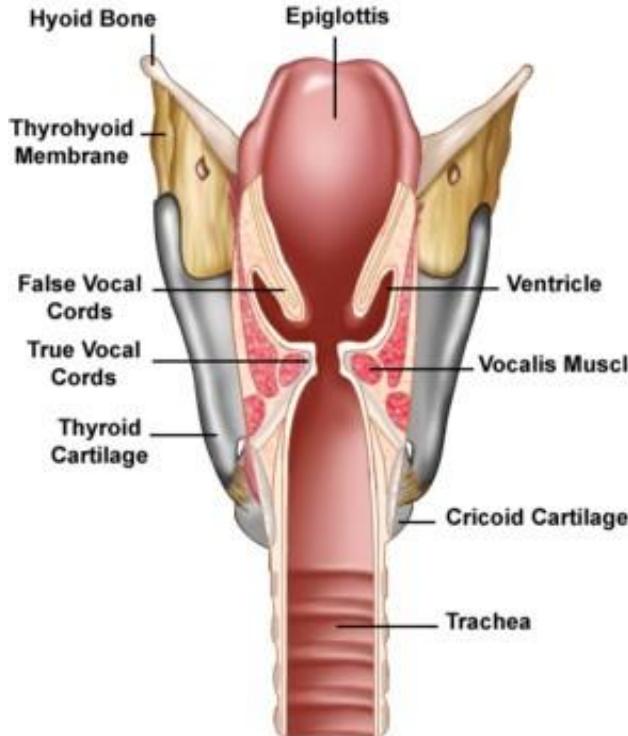
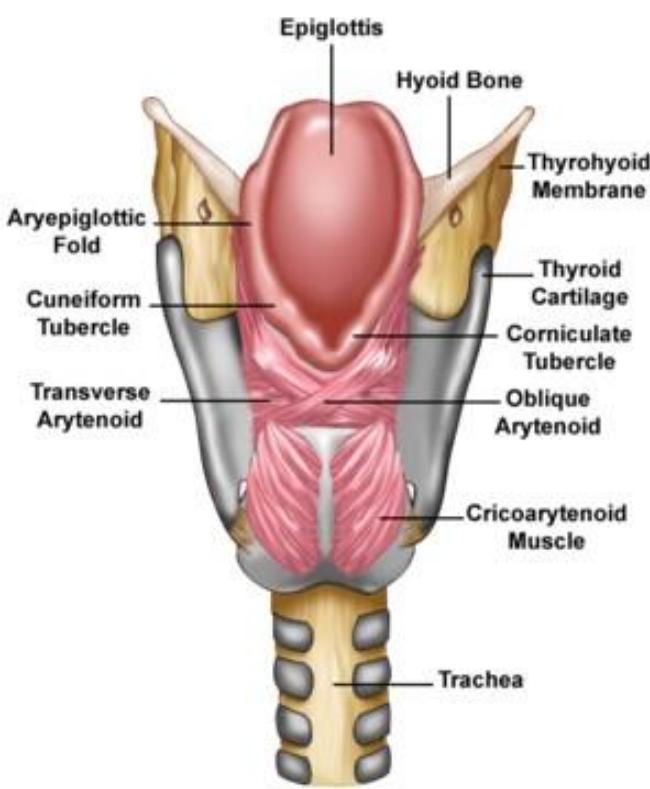
LARYNG

- Setinggi VC. IV – VC. VI
- Pembentuk laryng (9 cartilago)
 - cart. epiglottica
 - cart. tyroid
 - cart. cricoid
 - cart. arytenoid
 - cart. corniculatum
 - cart. cuneiforme

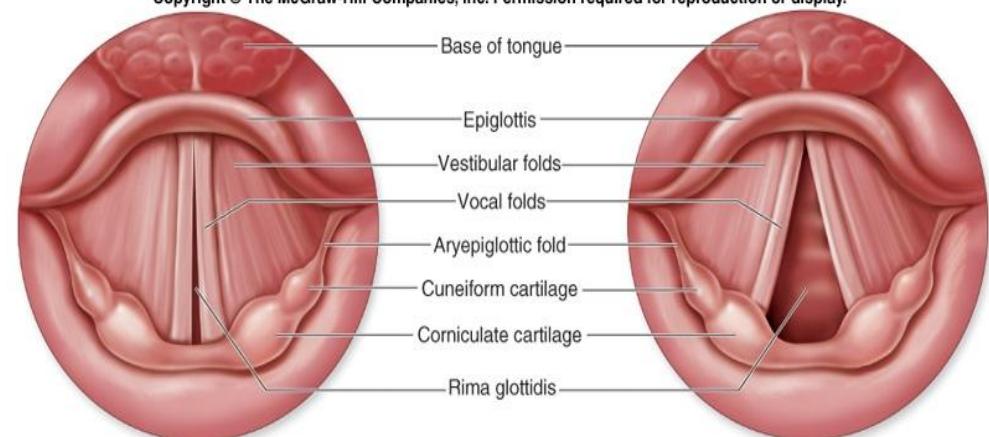


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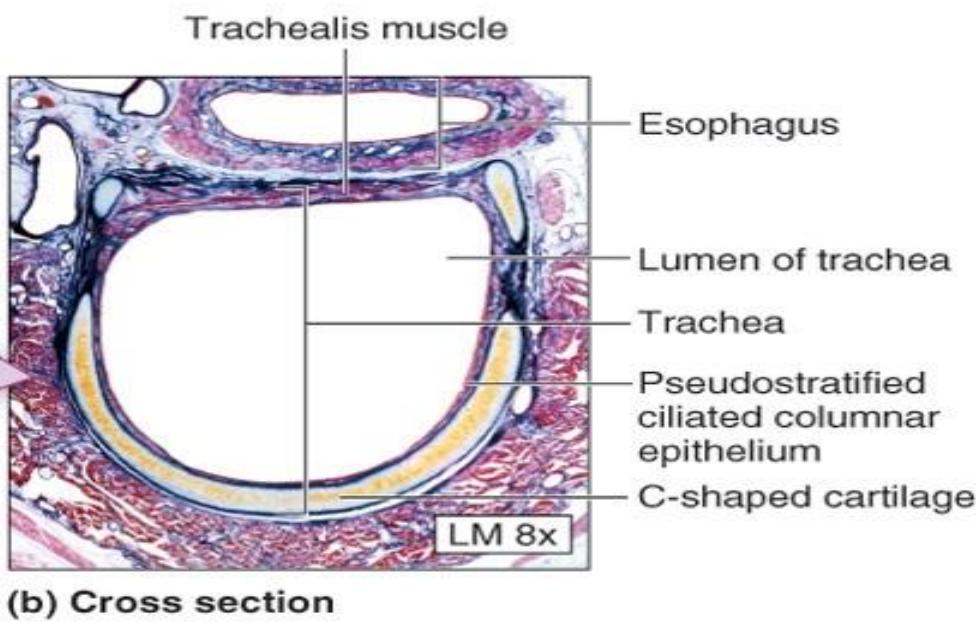
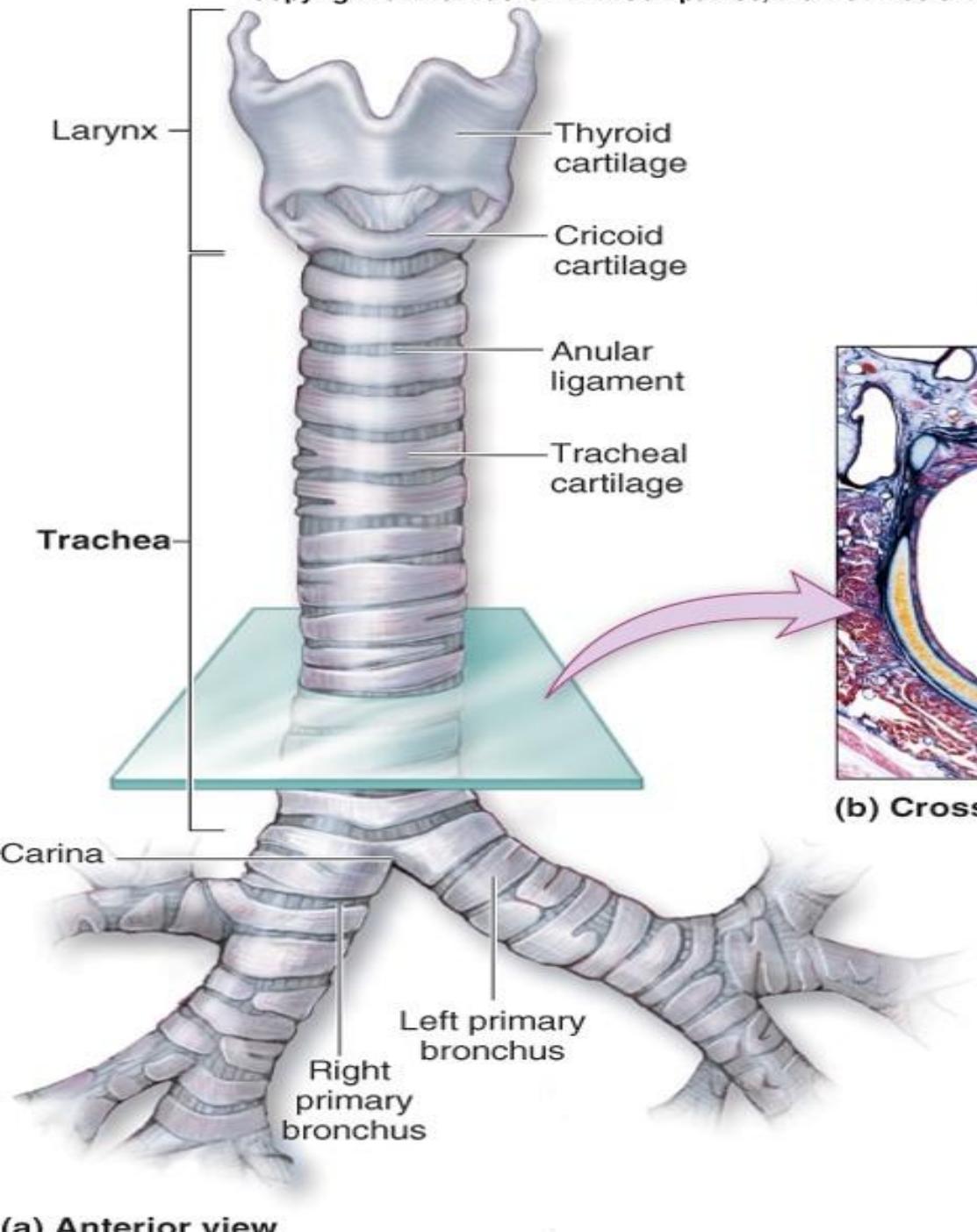


(b) Laryngoscope view

TRACHEA



- Mulai dari VC. VI (cart.cricoid)
 - Panjang 13-15 cm, diameter 2,5 cm
 - Terdiri atas 16 – 20 cincin tulang rawan yg saling dihubungkan oleh lig. Annularis
 - Bifurcatio trachea → VTh. IV-V
-
- ✖ Selaput lendir tersusun atas ***sel-sel epitel berambut getar (silia)*** yang berfungsi untuk menahan dan mengeluarkan kotoran-kotoran/debu-debu yang masuk.



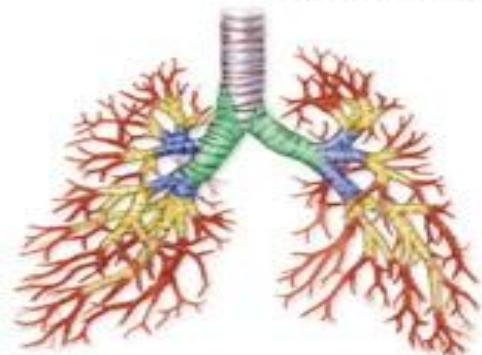
Bronchus

Terdiri atas :

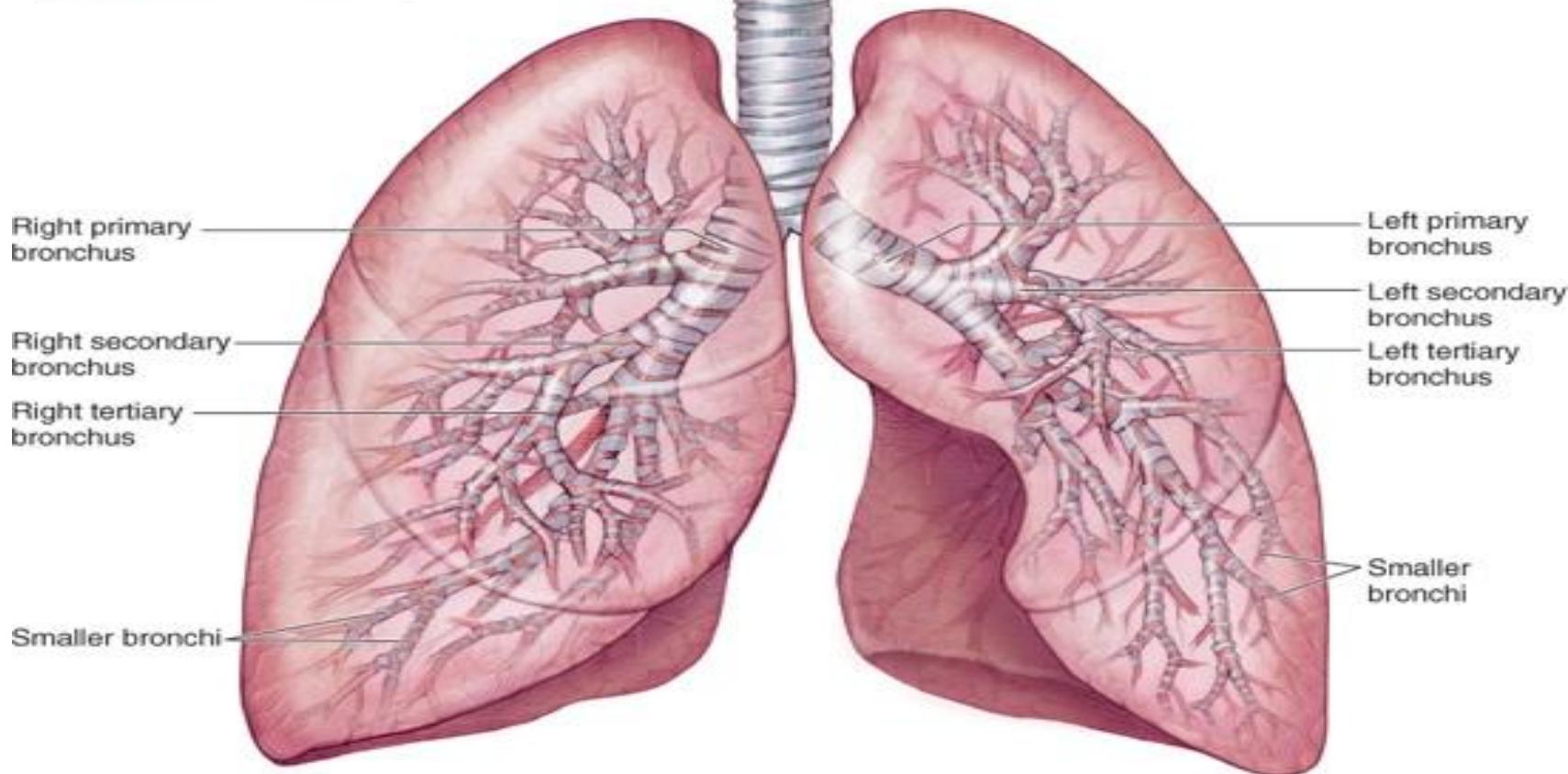
- bronchus principalis
- bronchus lobaris
- bronchus segmentalis

Bronchus Principalis

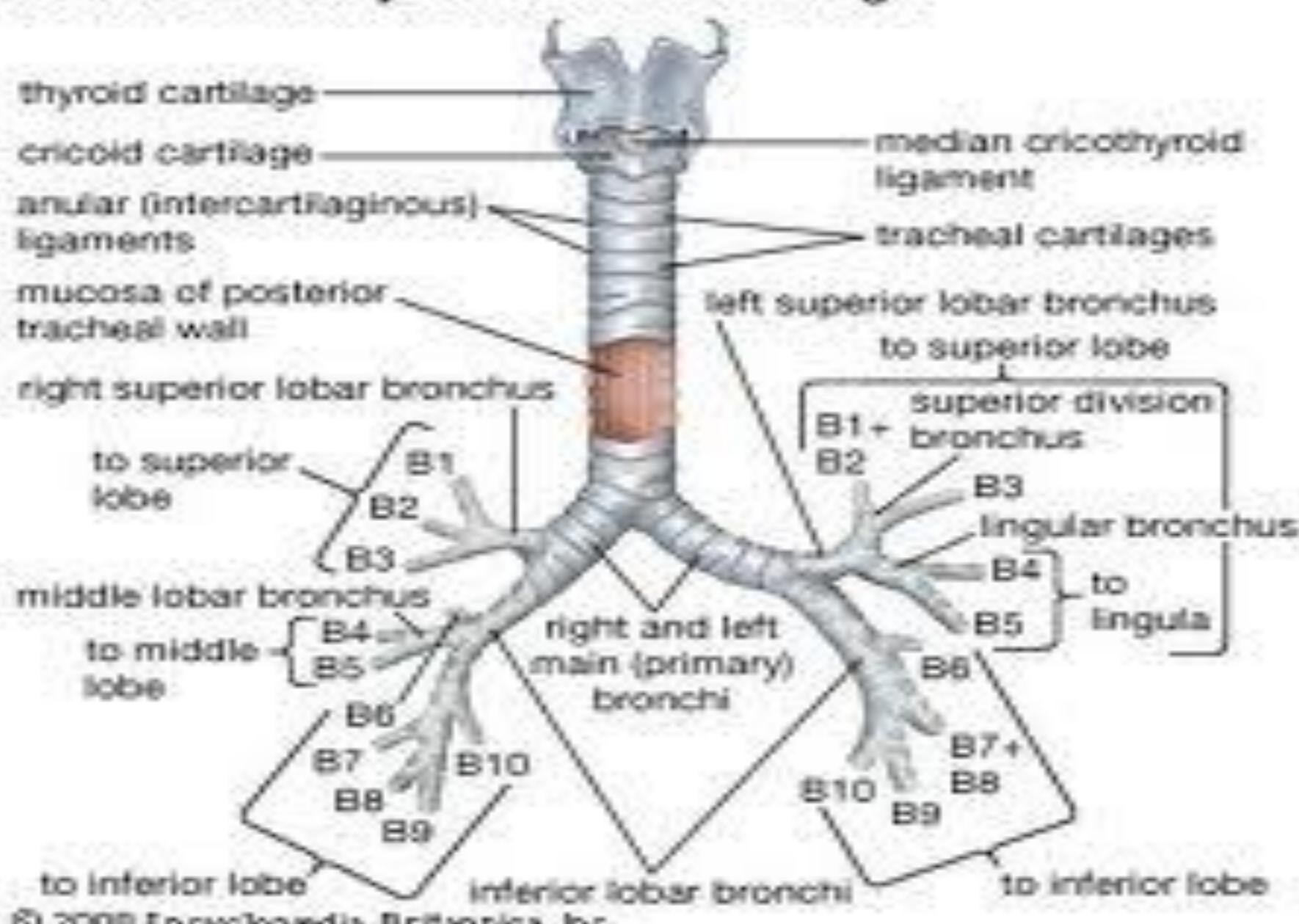
dextra	sinistra
- ukuran pendek (2,5 cm)	- ukuran lebih panjang (5 cm)
- lebih vertikal	- lebih horizontal
- diameter lebih besar	- diameter lebih sempit



- Primary bronchi
- Secondary bronchi
- Tertiary bronchi
- Smaller bronchi



Trachea and major bronchi of the lungs



BRONCHOPULMONARY SEGMENT

- **Bronchus principalis dextra**

- a. **bronchus lobaris superior dextra**

- bronchus segmentalis apical
 - bronchus segmentalis posterior
 - bronchus segmentalis anterior

- b. **bronchus lobaris media dextra**

- bronchus segmentalis lateralis
 - bronchus segmentalis medialis

- c. **bronchus lobaris inferior dextra**

- bronchus segmentalis superior
 - bronchus segmentalis basalis medialis
 - bronchus segmentalis basalis anterior
 - bronchus segmentalis basalis lateralis
 - bronchus segmentalis basalis posterior

BRONCHOPULMONARY SEGMENT (LANJ...)

- **Bronchus principalis sinistra**

- a. **bronchus lobaris superior sinistra**

- bronchus segmentalis apicoposterior
 - bronchus segmentalis anterior
 - bronchus lingularis superior
 - bronchus lingularis inferior

- b. **bronchus lobaris inferior sinistra**

- bronchus segmentalis superior
 - bronchus segmentalis basalis medialis
 - bronchus segmentalis basalis anterior
 - bronchus segmentalis basalis lateralis
 - bronchus segmentalis basalis posterior

BRONCHIOLUS

- jalan napas intralobular berdiameter \leq 5 mm
- Tidak memiliki tlg rawan maupun kelenjar dalam mucosanya
- Terdiri atas :
 - bronchiolus terminalis
 - bronchiolus respiratorius

ALVEOLUS

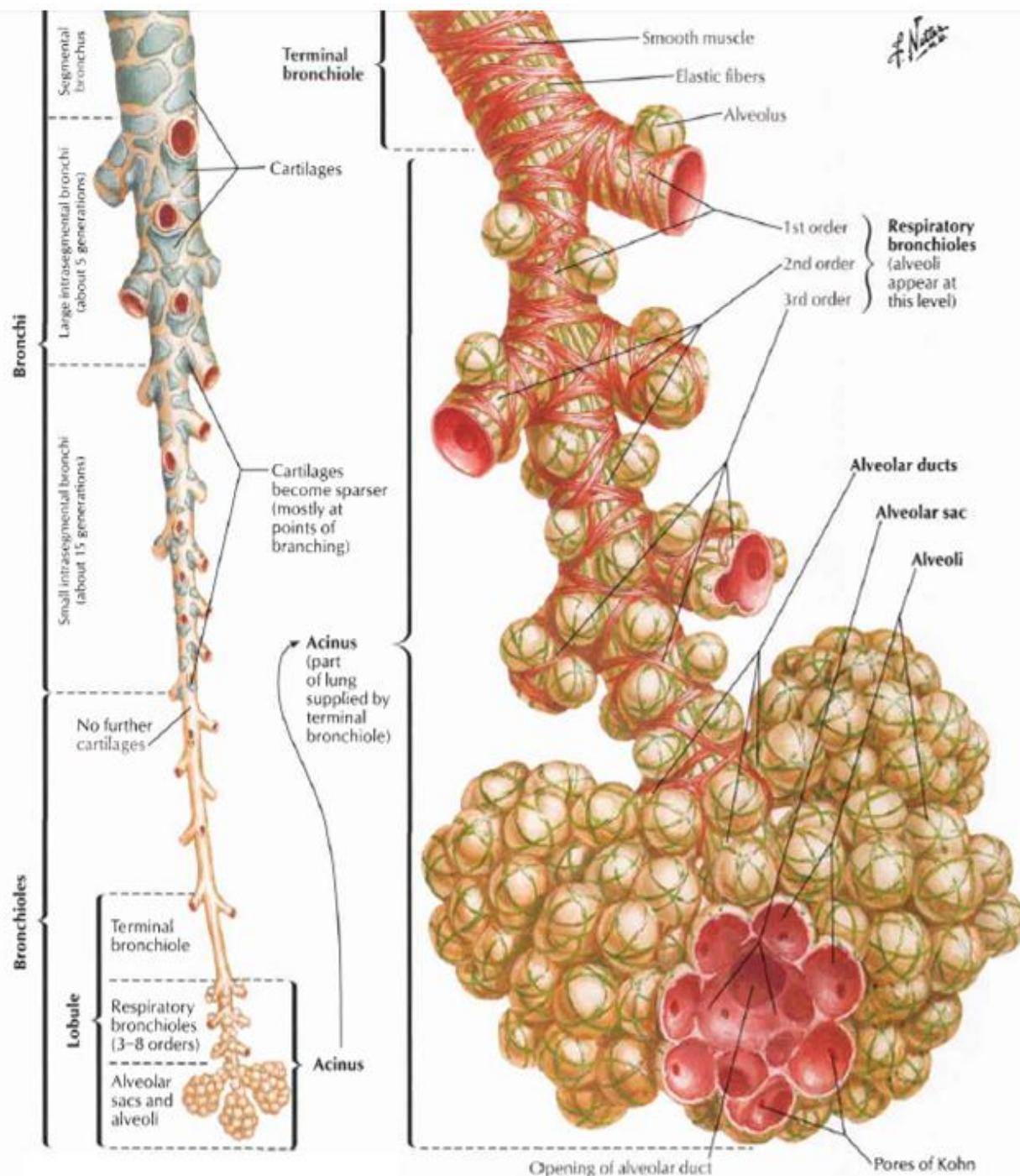


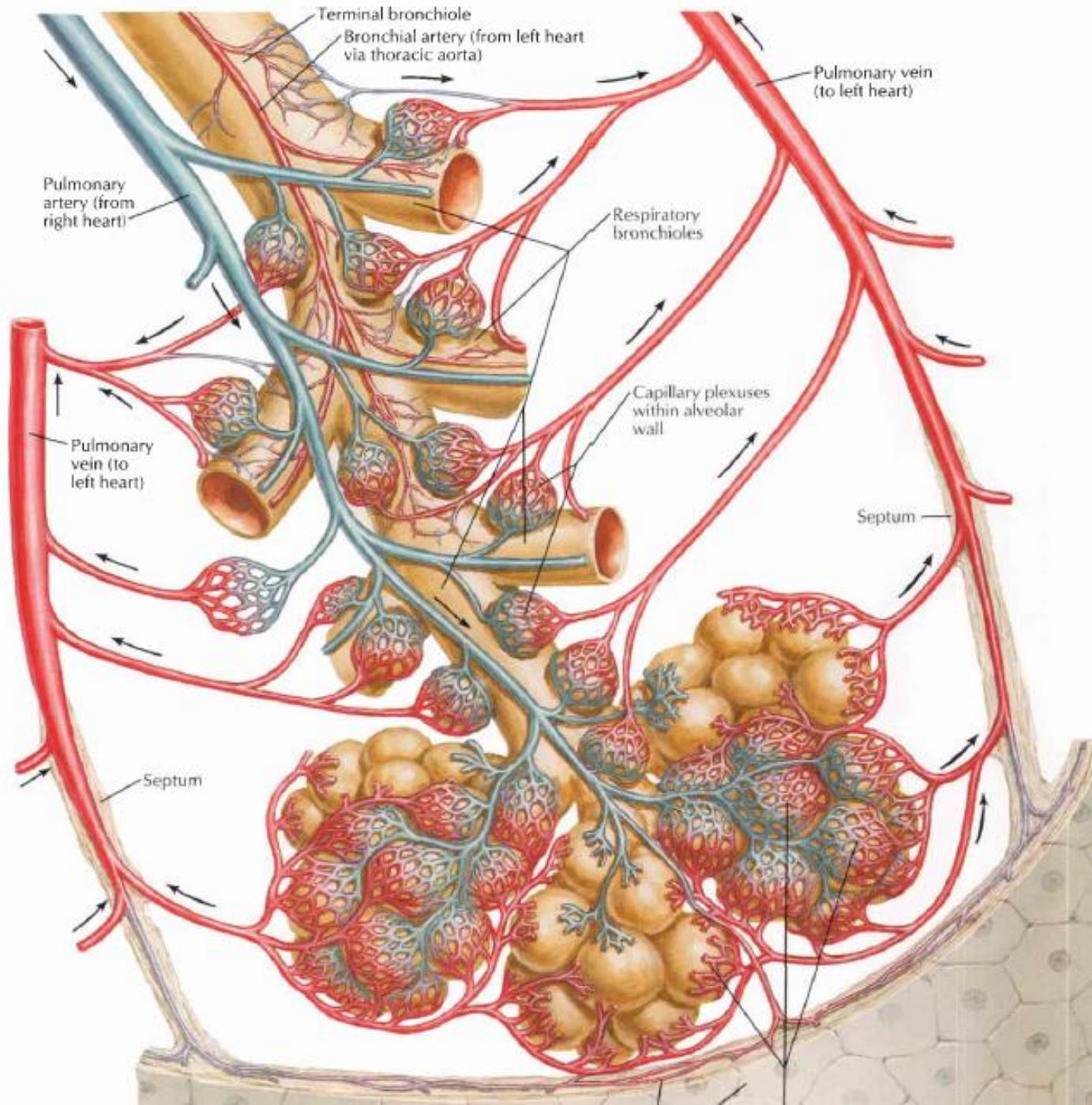
- Jumlah : sekitar 300 juta
- Luas : 80-100 m²
- Dinding sangat tipis, elastis dan mengandung pembuluh kapiler darah
- Tdd:
 - duktus alveolaris
 - sakus alveolaris
 - septum alveolaris
- Ø 0,1-0,2 mm, tersusun berkelompok pd duktus alv.
- Mengisi 50-60% dari seluruh volume paru

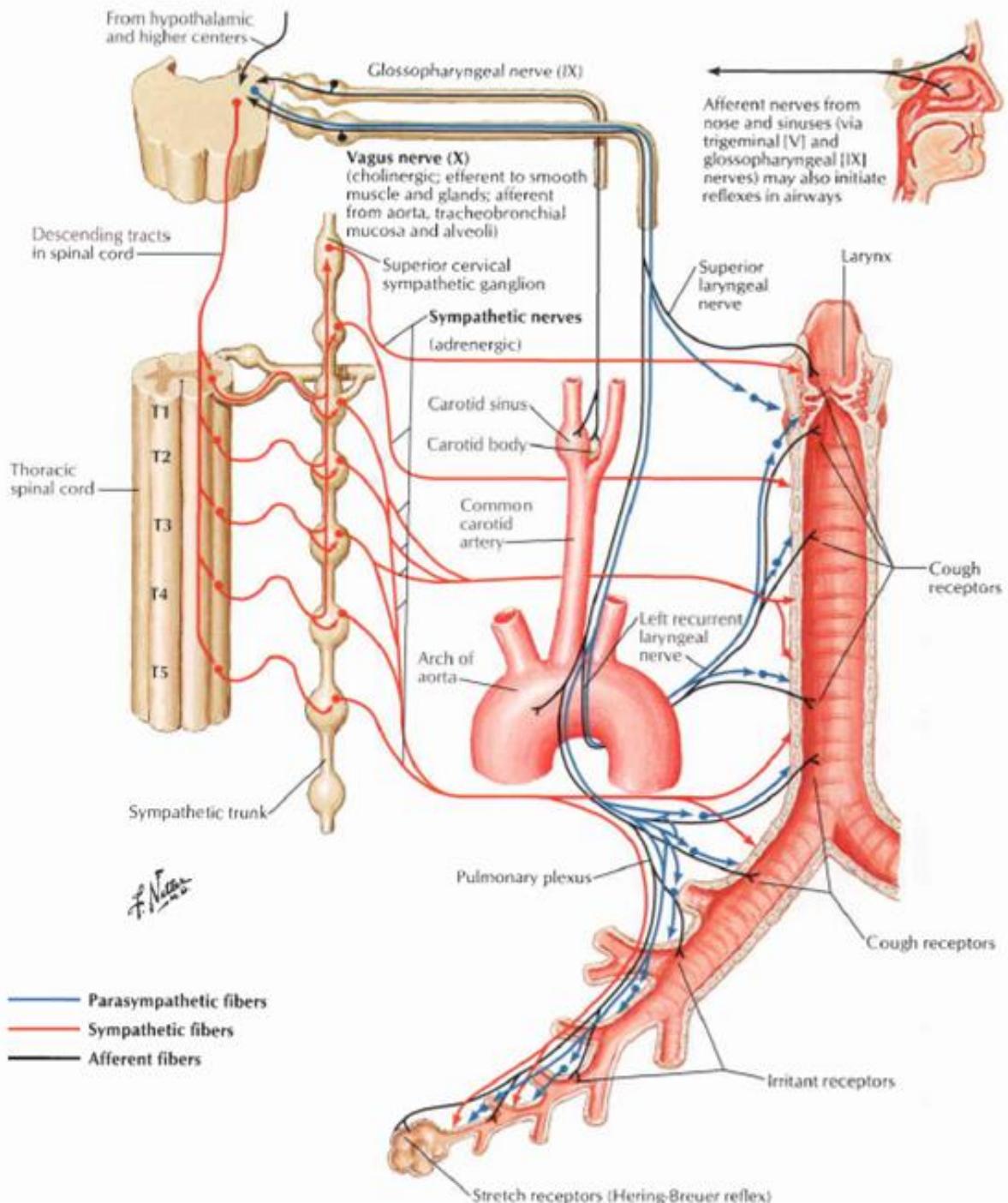
ALVEOLUS

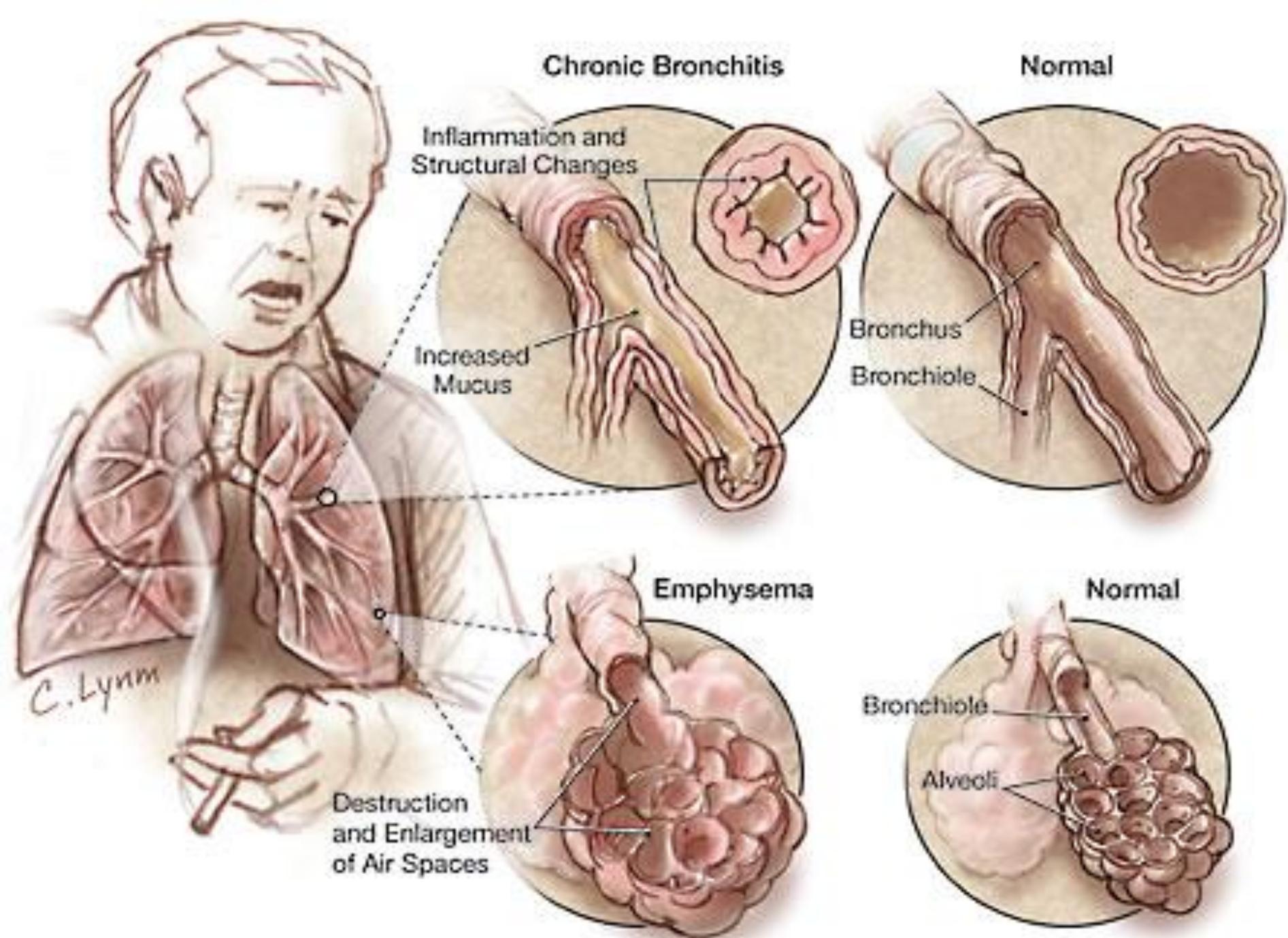


- Permukaan dalam dinding alveoli:
 - biosintesis surfaktan
 - sel-sel radang histiosit & makrofag (fagositosis)
- Dinding luar diliputi oleh kapiler → membran alveolo-kapiler → pertukaran gas O₂ & CO₂
- Sel-sel alveoli:
 - Pneumosit tipe I, melapisi sebagian besar alv
 - Pneumosit tipe II
 - * jumlah lebih sedikit
 - * pembuatan & penyimpanan surfaktan
 - * bentuk globular
- Porus Kohn → lubang pd alveoli yg menghubungkan alveoli satu dg lainnya









PLEURA

- Pulmo dilapisi oleh pembungkus → pleura
- Pleura terdiri atas pleura parietalis dan pleura visceralis
- Di antara kedua pleura tersebut → cavum pleura (cairan pleura sebagai pelumas 0,1-0,2 ml/kgBB atau 5 – 15 ml, tebal 10-20 µm)

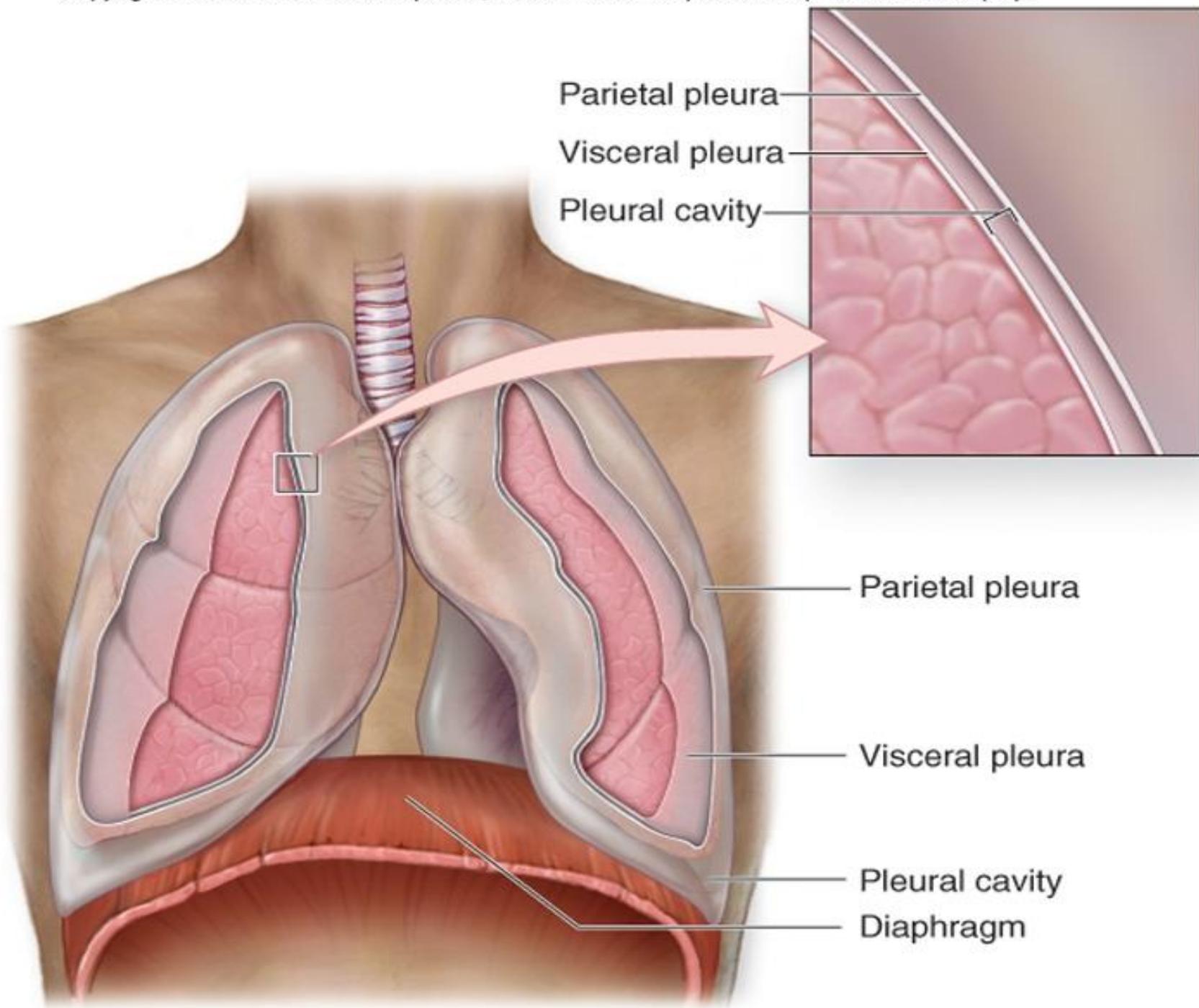
Pleura parietalis

Jenis	Innervasi	Penjalaran Nyeri
pleura cervicale		
pleura costalis	n.intercostalis	belakang costae atau ICS
pleura diafragmatica	- n.phrenicus [sentral] - n.intercostalis [perifer]	kuduk dan bahu dinding lateral thoraks, ventral abdomen
pleura mediastinalis	n.phrenicus	kuduk dan bahu

Pleura Visceralis

Innervasi: sistem otonom

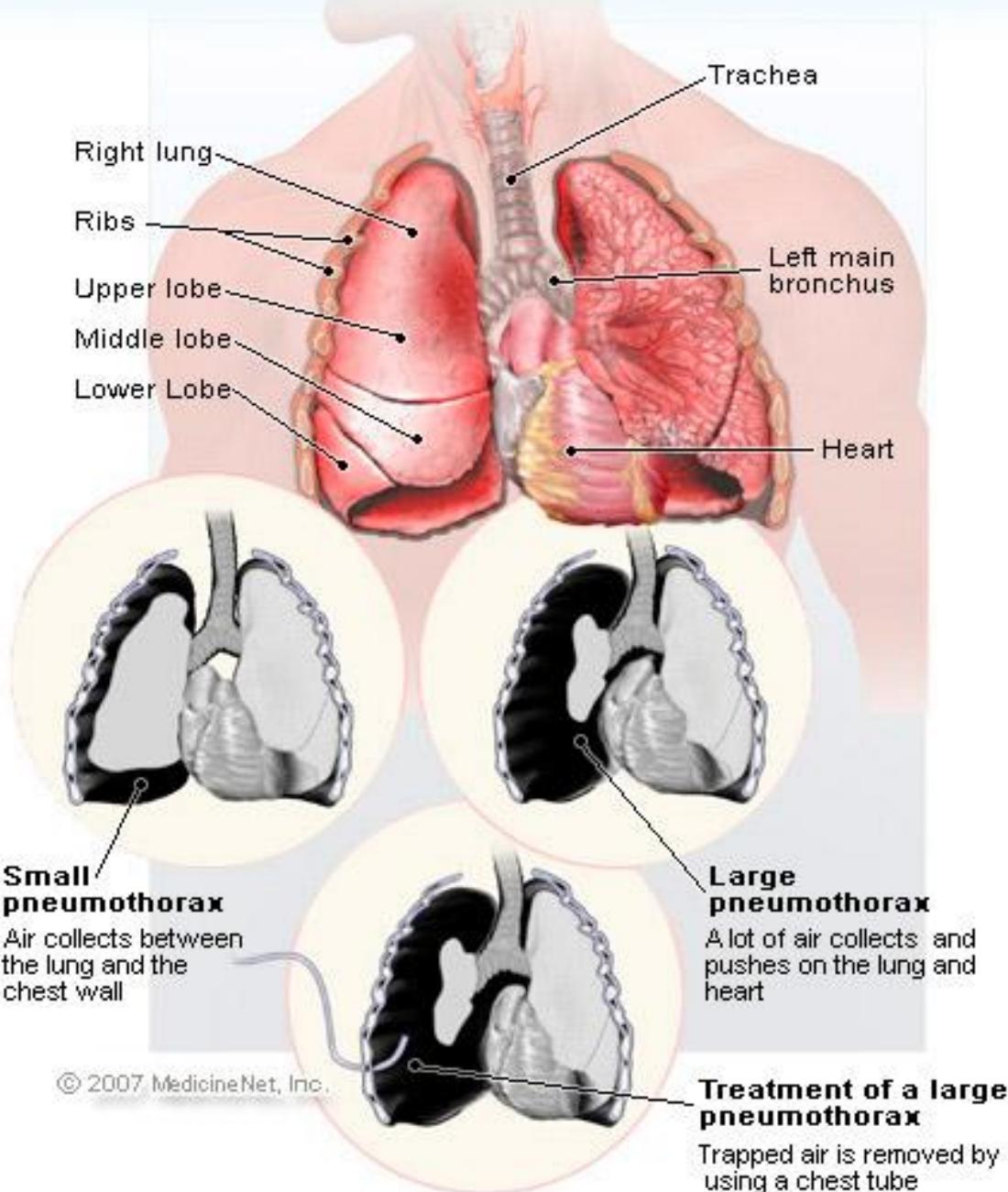
tak peka sensasi nyeri dan raba



EFUSI PLEURA

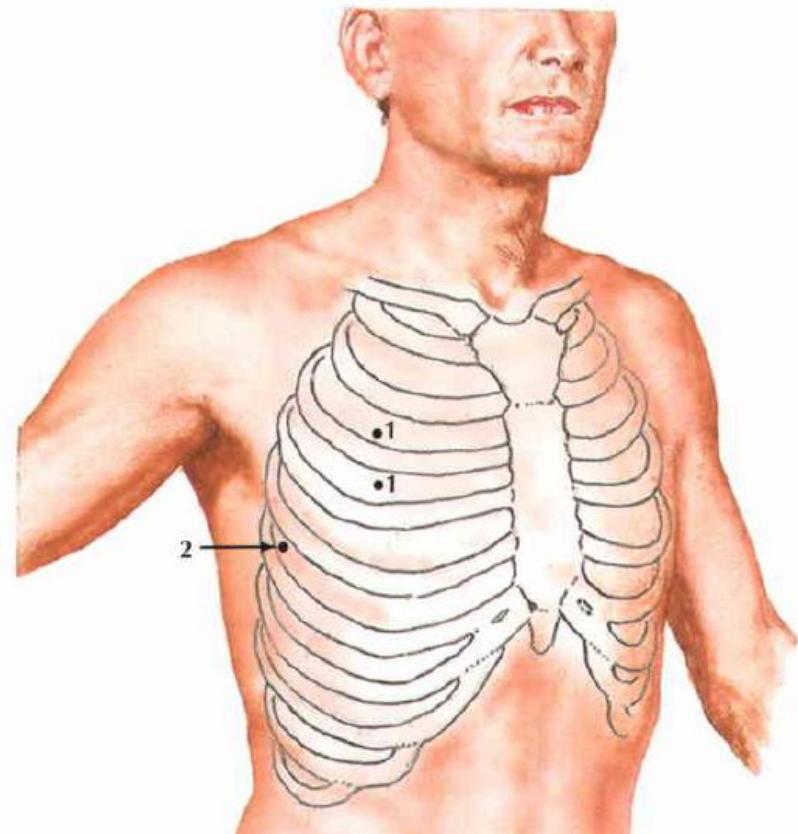
TIPE EFUSI	PATOGENESIS	KASUS
Transudat (< 30 gr protein/liter)	Peningkatan tekanan hidrostatik	Gagal jantung
	Penurunan tekanan onkotik	<ul style="list-style-type: none">- Obstruksi vena cava- Hipoalbuminemia
Eksudat <td>Infeksi</td> <td><ul style="list-style-type: none">- Bakterial, berhubungan dgn TB- Organisme lain</td>	Infeksi	<ul style="list-style-type: none">- Bakterial, berhubungan dgn TB- Organisme lain
	Neoplasma	<ul style="list-style-type: none">- Karsinoma metastasis- Karsinoma paru primer- Mesothelioma pleura
	Infark paru	Penyakit tromboembolik
	Penyakit autoimun	<ul style="list-style-type: none">- Penyakit rematik- Lupus eritematosus sistemik (LES)
	Penyakit abdomen	<ul style="list-style-type: none">- Pankreatitis- Abses subphrenicus- Meig's Syndrome

Pneumothorax



Preferred sites

1. For pneumothorax (2nd or 3rd interspace at midclavicular line)
2. For hemothorax (5th interspace at midaxillary line)



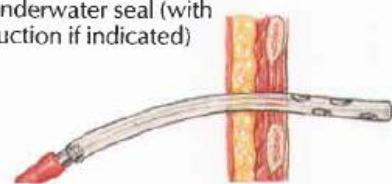
A. Trocar and cannula pushed through intercostal space



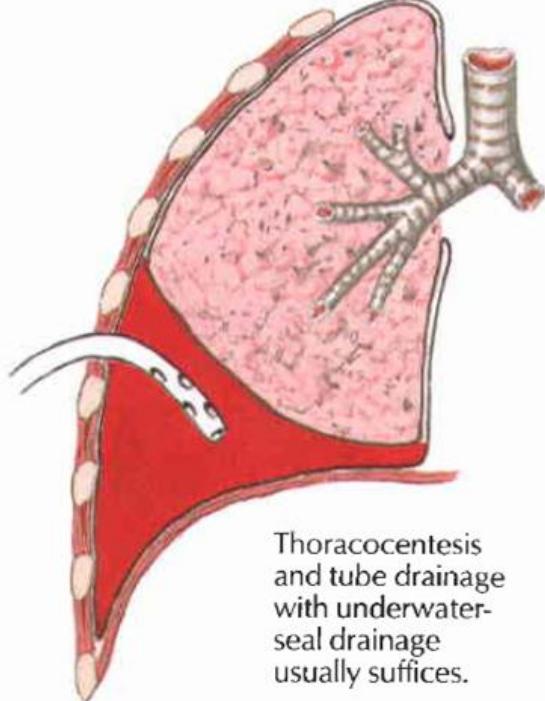
B. Trocar withdrawn; tube passed into chest through cannula



C. Cannula withdrawn; tube connected to underwater seal (with suction if indicated)



D. Intercostal →
space is pierced above
rib to avoid
damage to
neurovascular
bundle lying in
costal groove



PULMO

○ Pulmo terdiri atas :

a. pulmo dextra

- 3 lobus (superior, media, inferior)
- fissura horizontalis dan obliqua
- impresio (oesophageal, v.c superior, a.subclavia dextra, v. azygos, cardiaca)
- hylus (bronchus, a.pulmonalis , v.pulmonalis)

b. Pulmo sinistra

- 2 lobus (superior, inferior)
- fissura obliqua, incisura cardiaca
- impresio (a.subclavia sinistra, a.carotis comm sinistra, aorta ascenden, arcus aorta, aorta descendens, cardiaca)
- hylus (a.pulmonalis , bronchus, v.pulmonalis)

PULMO

- Terdiri atas 3 facies :

- facies diafragmatica
- facies costalis
- facies mediastinalis

- Terdiri atas 3 margo :

- margo anterior
- margo posterior
- margo inferior

- Vascularisasi paru

- aa.bronchiales (Nutritif) → bronchus, jar.ikat paru, pleura visceralis
- a. Pulmonalis (Fungsional) → alveolus

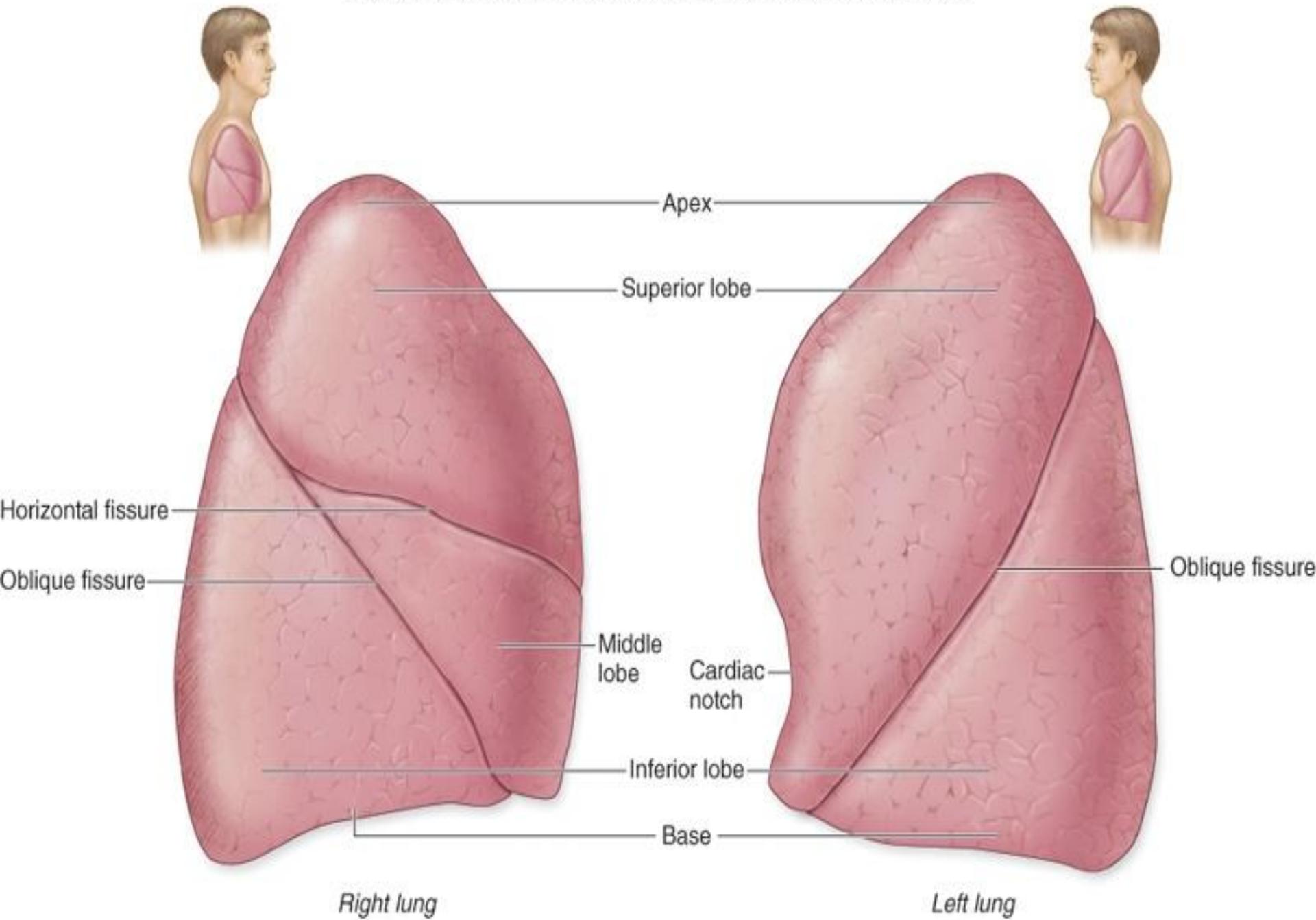
PULMO

○ Pembuluh limfe

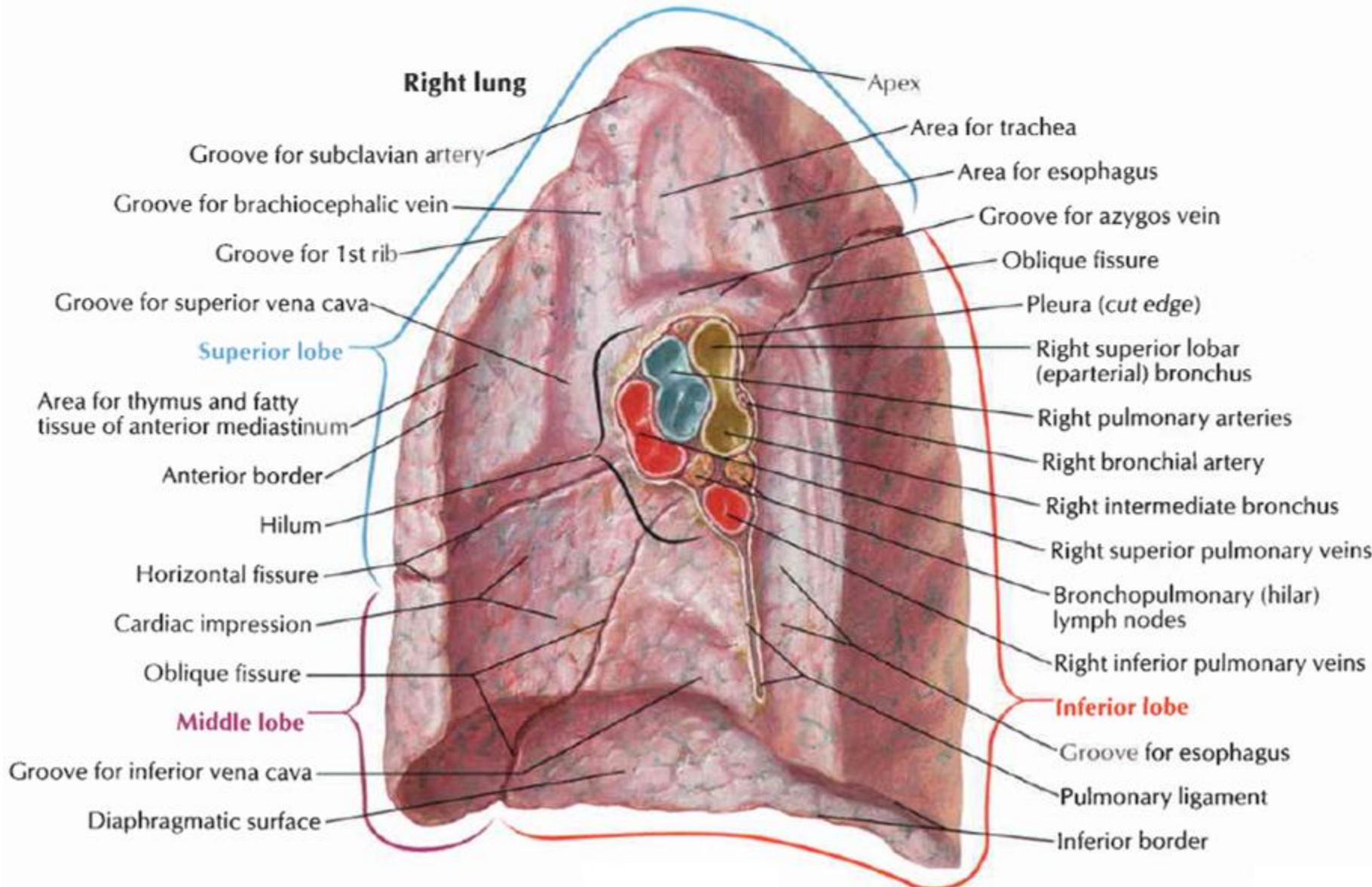
plexus superficial (pleura visceralis) + plexus profundus (bronchus, av.pulmonalis) / nodi pulmonis → nodi bronchopulmonalis → trunchus lymphaticus bronchomediastinalis → v.brachiocephalica/duc.thoracicus/duc.lymphaticus dexter

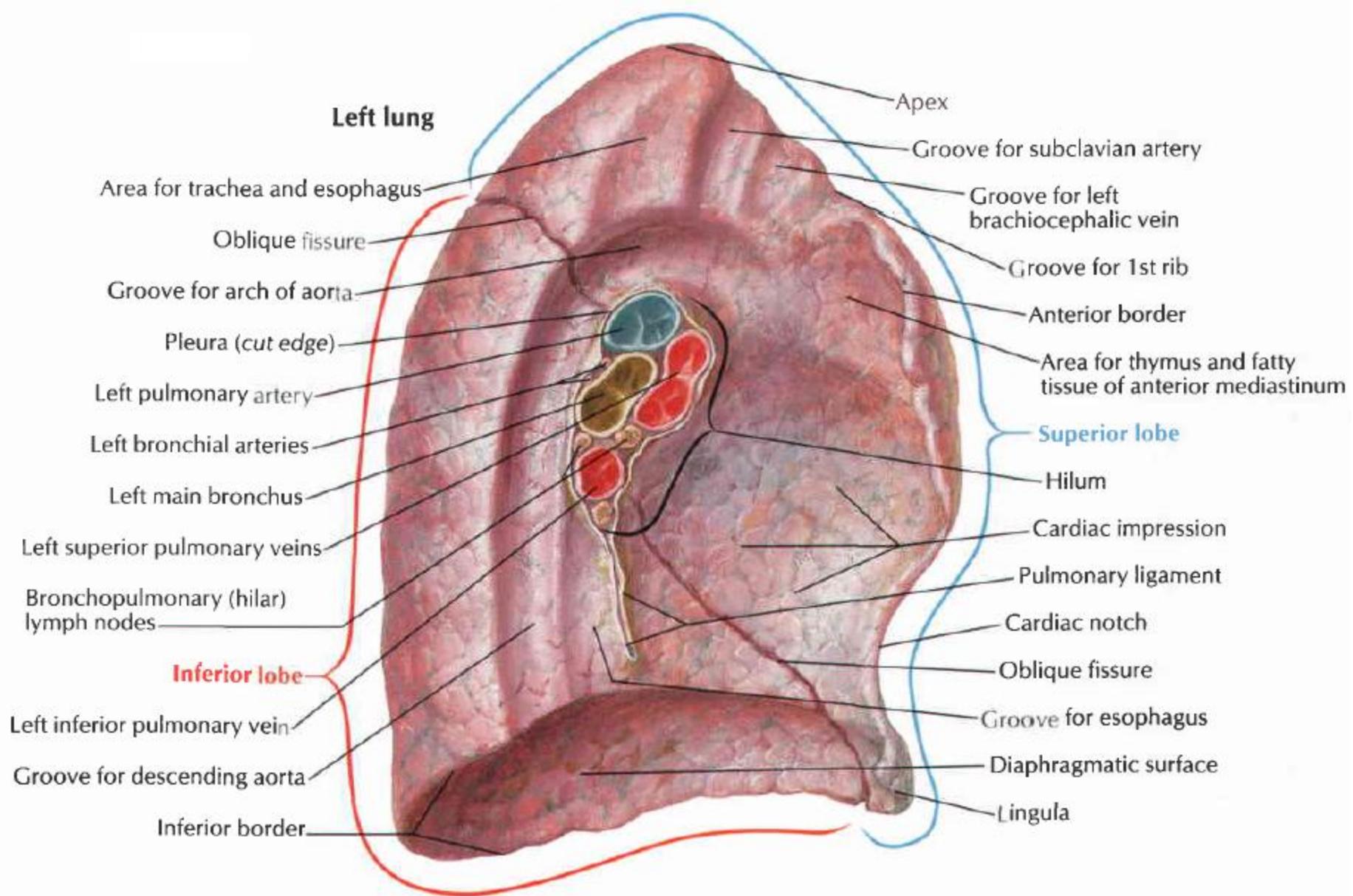
○ Innervasi

- simpatis (trunchus sympatheticus)
bronchodilatasi dan vasokonstriksi
- parasimpatis (n.vagus)
bronchokonstriksi, vasodilatasi, peningkatan sekresi kelenjar



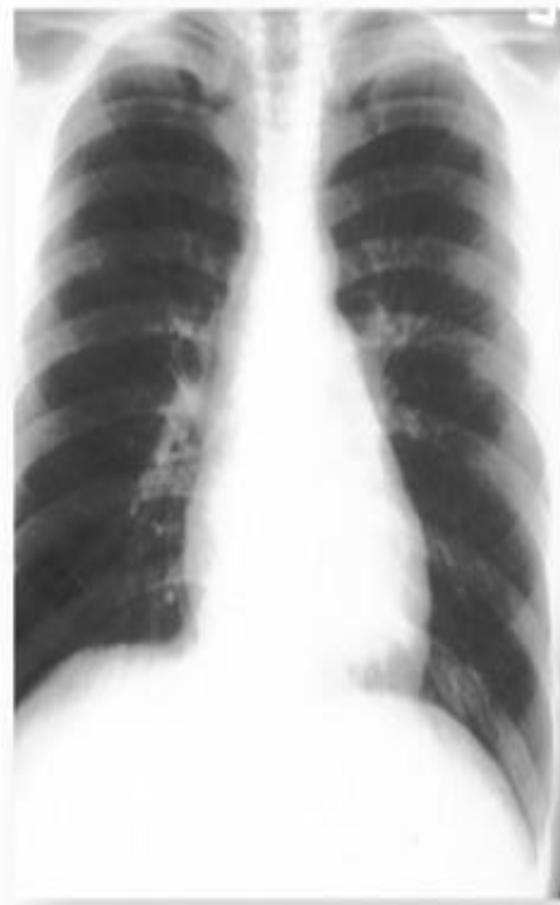
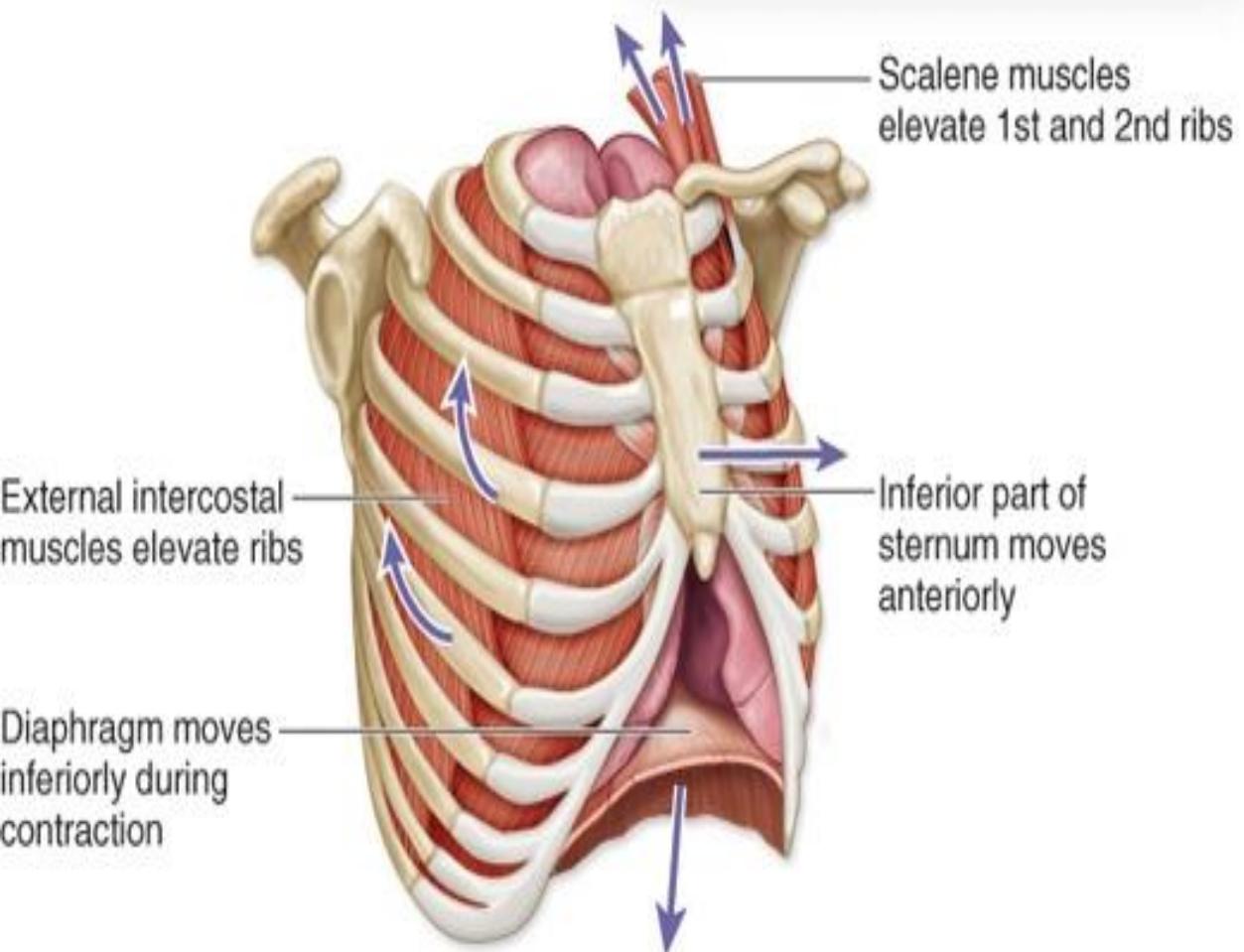
(a) Lateral views





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Inhalation



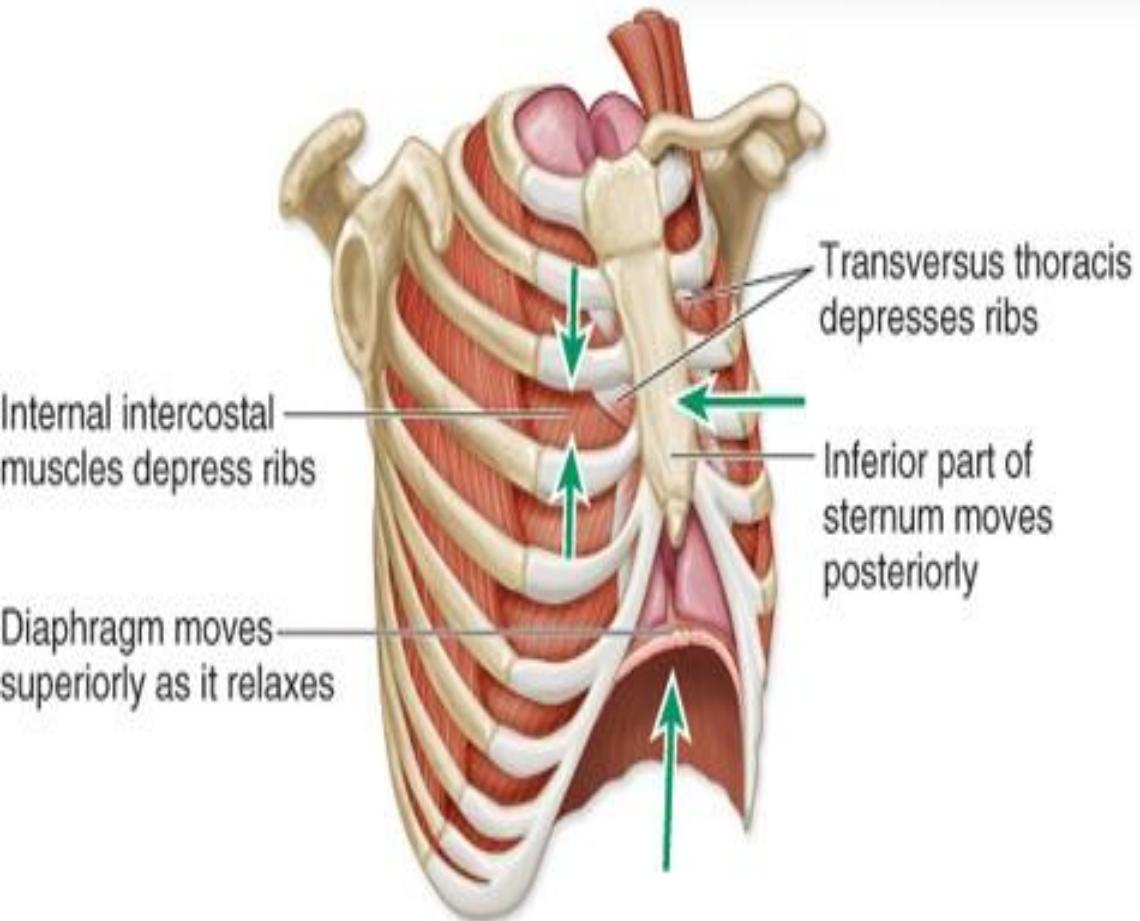
Inspirasi

Otot Inspirasi Utama	
M. Intercostalis externus	Mengangkat costae
M. Intercartilagineus parasternalis	Mengangkat costae
Diafragma	Memperbesar rongga dada dan mengangkat costae bagian bawah

Otot inspirasi tambahan

M. sternocleidomastoideus	Mengangkat sternum
M. Scalenus (anterior, medius, posterior)	Mengangkat dan memfiksasi costae bagian atas

Exhalation



Ekspirasi

Saat bernafas biasa tidak memerlukan kegiatan otot, cukup dgn daya elastisitas paru

Otot ekspirasi aktif	
M. Intercostalis internus	Menekan costae
M. Rectus abdominis	Menekan costae bagian bawah dan mengecilkan cavum abdomen
M. Obliquus abdominis	Menekan costae bagian bawah dan mengecilkan cavum abdomen
M. Abdominis internus	Menekan costae bagian bawah dan mengecilkan cavum abdomen
M. Tranversus abdominis	Menekan costae bagian bawah dan mengecilkan cavum abdomen

Muscles of Inspiration

Accessory

Sternocleido-mastoid
(elevates sternum)

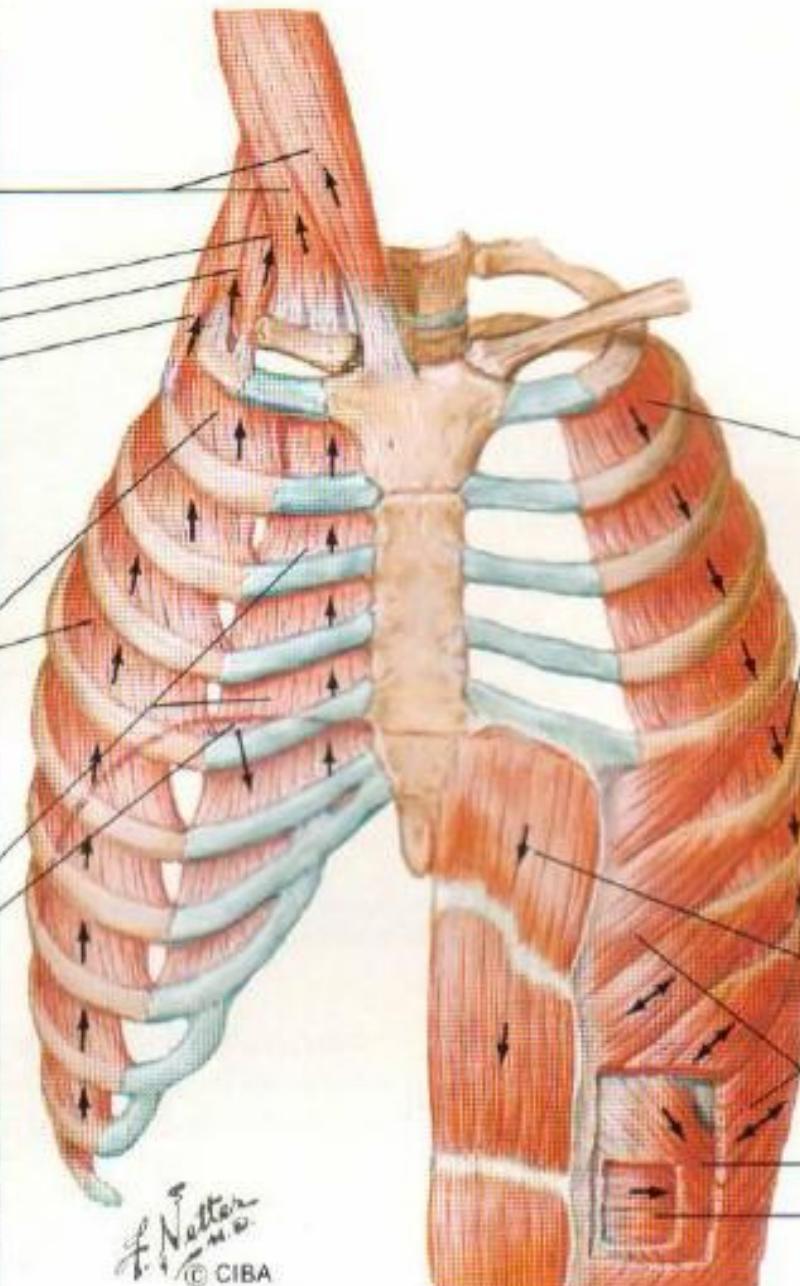
Scalenus
anterior
middle
posterior
(elevate and
fix upper ribs)

Principal

External
intercostals
(elevate ribs)

Parasternal
intercartilaginous
muscles
(elevate ribs)

Diaphragm
(domes descend,
increasing
longitudinal
dimension of
chest and
elevating
lower ribs)



Muscles of Expiration

Quiet breathing

Expiration
results from
passive recoil
of lungs

Active breathing

Internal
intercostals,
except
parasternal
inter-
cartilaginous
muscles
(depress ribs)

Abdominal
muscles
(depress lower
ribs, compress
abdominal
contents)

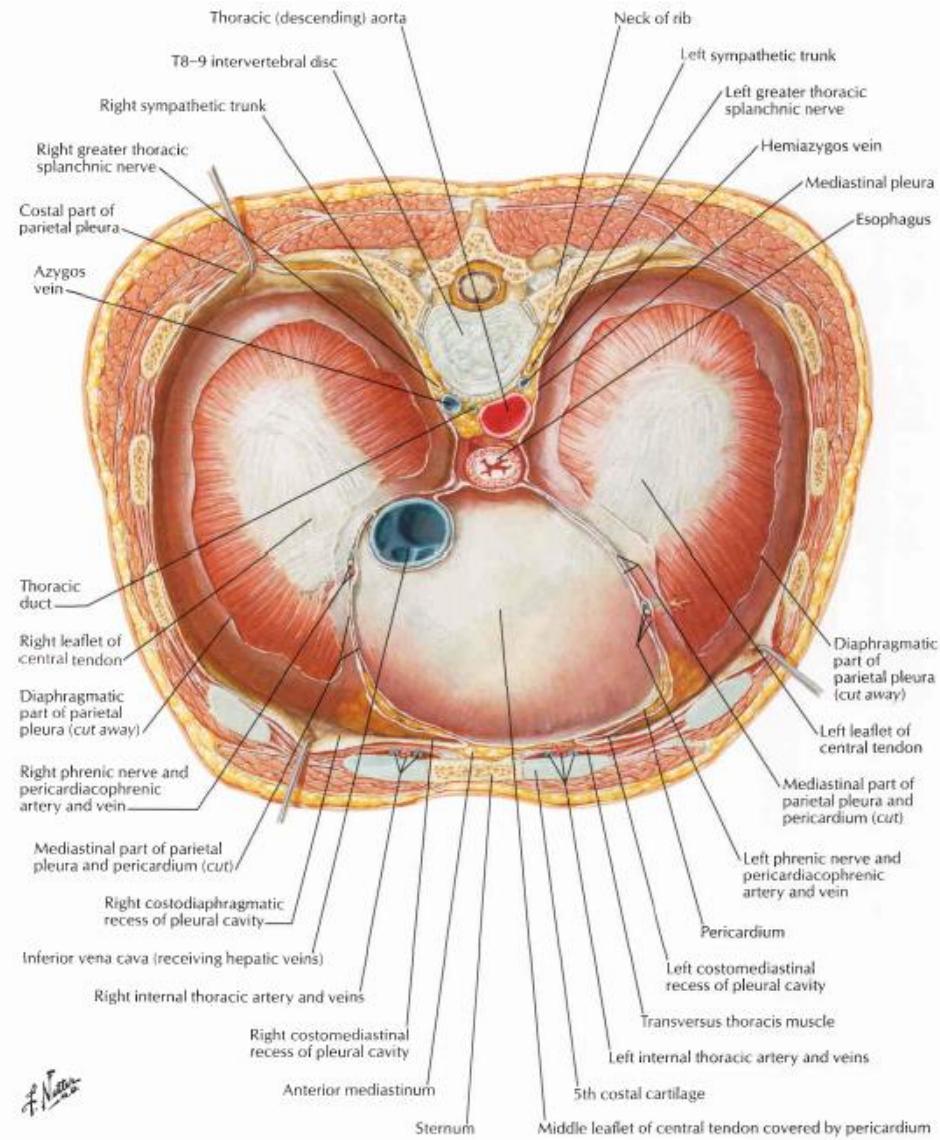
rectus
abdominis
external
oblique
internal oblique
transversus
abdominis

Diafragma

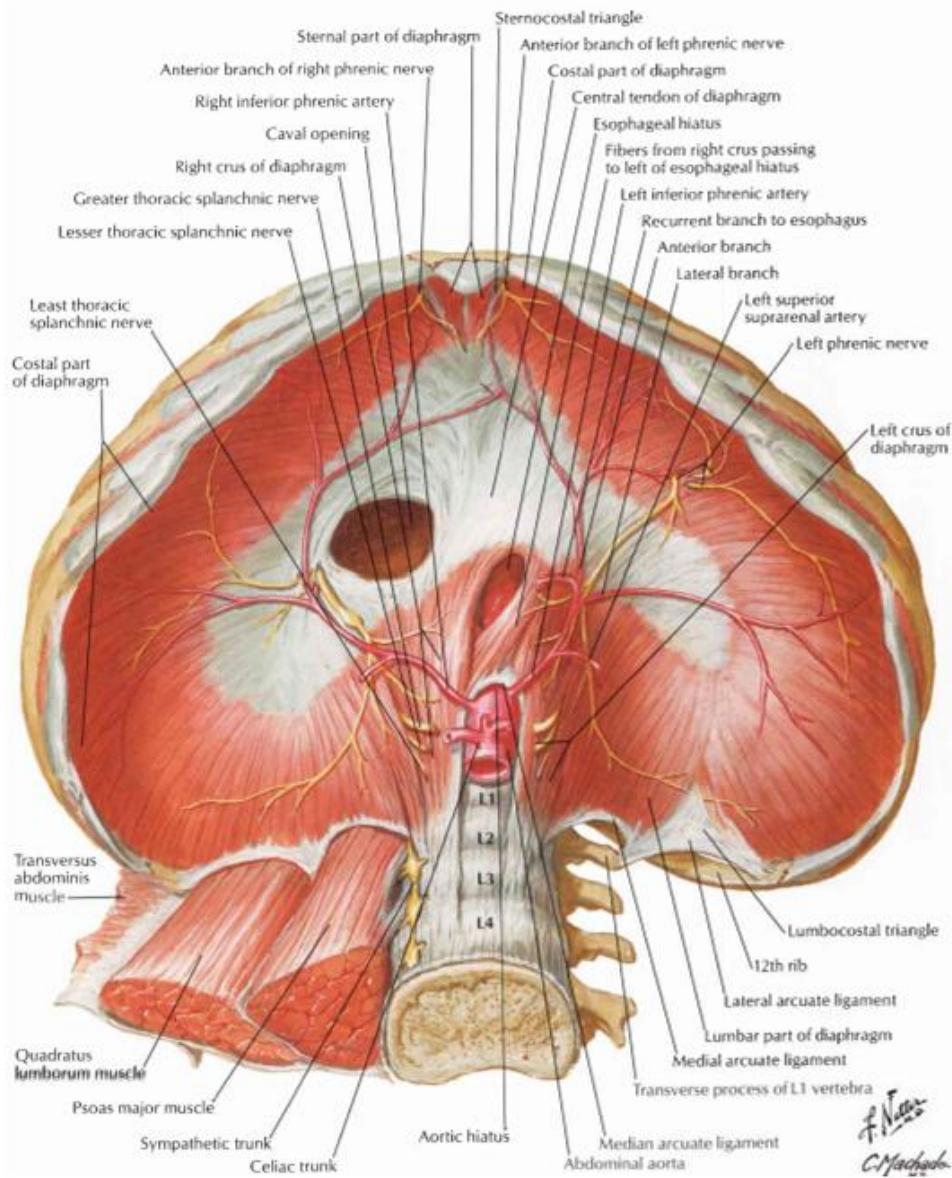


- Terdiri dari :
 - centrum tendineum
 - pars muscularis
- 3 lubang pd diafragma :
 - Hiatus V.C inferior → VTh. VIII
(V.C inferior, n.phrenicus)
 - Hiatus Oesophagus → VTh. X
(oesophagus, n.vagus)
 - Hiatus aorta → VTh. XII
(aorta, duc.thoracicus, v.azygos)

Thoracic Surface



Abdominal Surface



TERIMA KASIH

TERIMA KASIH

