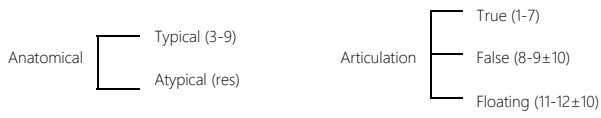


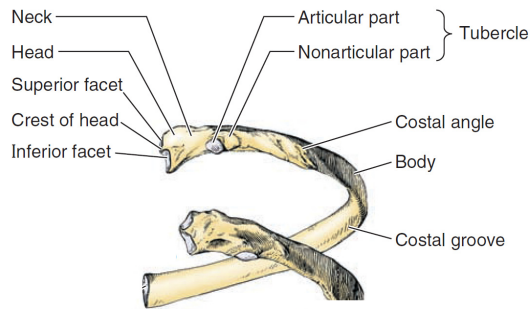
THORAX

SKELTON (Ribs + Vertebrae + Sternum)

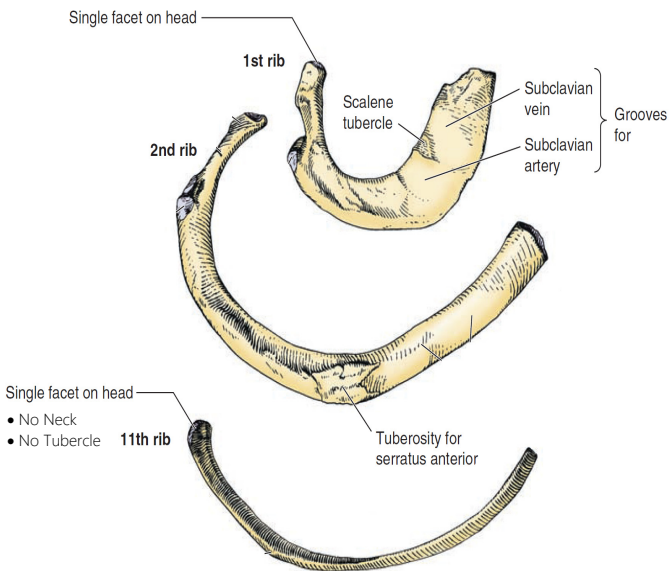
Ribs



Typical Ribs



Atypical Ribs



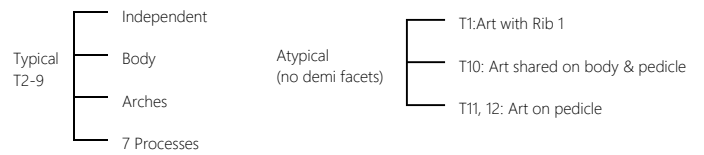
Costal Cartilages

- ↑ length from 1-7
- ↓ length from 8-12

Intercostal Spaces

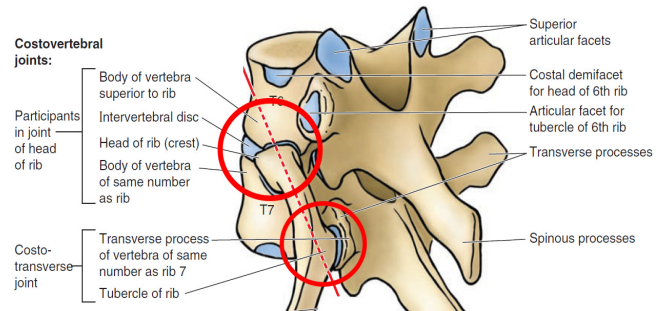
- Defined by rib making SUPERIOR border
- 11 spaces + subcostal space

Vertebrae

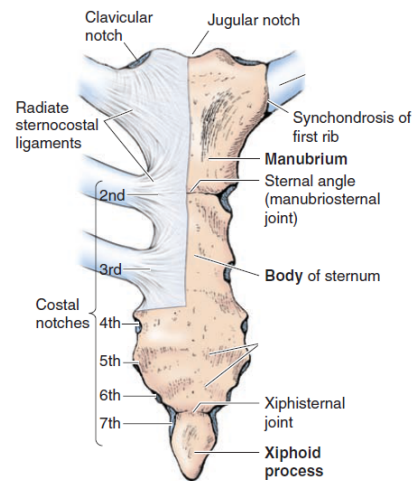


Specific Properties of THORACIC Vertebrae

- Costal facets on body (bilateral, sup & inf, as demi-facets, art with head of rib)
- Costal facets on transverse process (art with tubercle of same rib)
- Long spinous processes



Sternum



THORAX

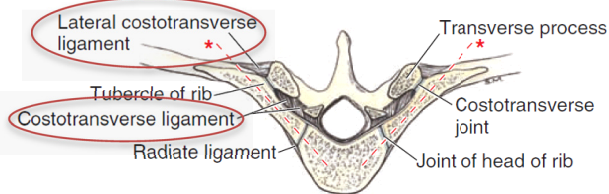
THORACIC APERTURES

Borders	Post	Ant	Lateral
Superior	T1	Jug Notch	1 st Ribs
Inferior	T12	Xiphisternal Jt	11 th - 12 th Ribs & 7 th - 10 th Costal Cart

JOINTS (costovertebral & sternocostal)

Costovertebral

- Head of rib ⇔ Demifacet of vert body above and @ level of
- Costotransverse (rib to transverse process)
 - Costotransverse: neck of rib
 - Lateral Costotransverse: tubercle of rib
 - Superior Costotransverse: crest of neck (to TP above)



Movements

- Pump Handle: Ribs 1 to 6
- Bucket Handle: Ribs 7 to 12

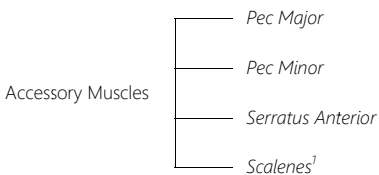
Sternocostal

- Rib 1 = tight synchondrosis (with clavicle as well)
- Rib 2 to 7 = loose synovial

Other Joints

- Xiphisternal (synchondrosis)
- Manubrosternal (symphysis)
- Sternoclavicular (saddle)

MUSCLES

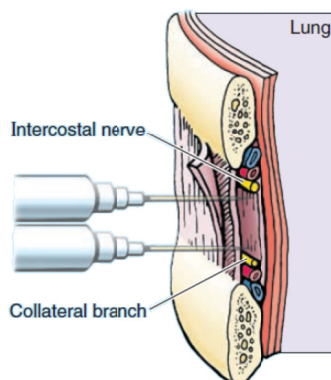


¹Fix 1st & 2nd Ribs

Muscle	Sup Attach	Inf Attach	Innervation	Action
Serr Post Sup	SP C7 to T3	2 nd to 4 th ribs sup border	2 nd to 5 th IC	Proprioception (elevate)
Serr Post Inf	SP T11 to L2	8 th to 12 th rib inf border	Ant rami T9 to T12	Proprioception (depress)
Levator Costarum	TP T7 to T11	Subjacent ribs ¹	Post rami C8 to T11	Elevate ribs
Ext IC		Sup border of rib		Elevate ribs ²
Int IC	Inf border of ribs	Sup border of rib below		Into: depress
Inm IC				Intc: elevate
Subcostal	Internal surf ribs ³	Sup border 2 nd or 3 rd rib below	IC	
Transversus Thoracis	Post lower sternum	Int surf costal cart 2 to 6		Depress ribs (weakly)

SP (spinous process) TP (transverse process) IC (intercostal)
 Into (interosseous part) Intc (interchondral part)

¹Btwn tubercle & angle
²During forced inspiration
³Near angle



NERVES

12 pairs of thoracic spinal nerves

- Exit as mixed nerve then separate into ant/post rami
- Ant rami T1-11 ⇒ Intercostal Nerves (T12 = subcostal nerve)
- Post rami ⇒ hts, deeo back muscles, skin on back

Typical IC Nerves (3rd to 6th)

Location	Position	Notes
Initial	Endothoracic fascia	(btwn parietal pleura & int IC membrane)
Angle of Rib	Btwn int ⇔ innermost IC	gives off collateral branches that travel along superior border of rib below
MAL		gives off lateral cutaneous branch
Anterior Rib Sternum	Pass btwn costal cartilage to form ant cut branches	Supply Skin

Atypical IC Nerves

Property
T1
T1, 2
T2 ± 3
T7-11

VASCULATURE

Artery	Origin	
Posterior IC	Space 1-2 Sup IC ¹ Space 3-11 Thoracic Ao	<ul style="list-style-type: none"> Posterior branch² Collateral branch runs along sup border of rib All anastomose @ MCL with ant intercostal arteries
Anterior IC	Space 1-6 Int Thoracic ¹ Space 7-9 MP ³	<ul style="list-style-type: none"> Supply anterior upper 9 spaces Travel along margins of ribs above & below Spaces 1,2 lie in endothoracic fascia Spaces 3-6 separated by transversus thoracis Spaces 7-9 from MP³ Spaces 10-11 absent
Subcostal	Thoracic Ao	<ul style="list-style-type: none"> Course along inf border of 12th rib Supply to muscles of ant/lat abdo wall

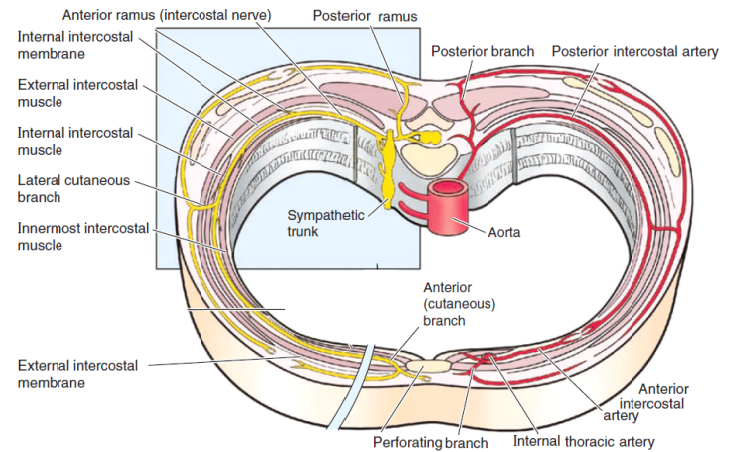
¹Branch of Subclavian

²Runs with post ramus supplying cord, column, back muscles, skin

³Musculophrenic, branch of Int Thoracic

Course of int. thoracic artery

- Branch of Subclavian on inf border
- Phrenic nerve crosses near origin
- Desc post to davicle & 1st rib
- Desc ant to transversus thoracis
- Terminate in 6th space by branching into superior epigastric & musculophrenic arteries



IC vein	1 st draining part	2 nd drain
1	Brachiocephalic	SVC
2, 3 ± 4	Sup IC vein	SVC
4-11	Hemi/azygous	SVC

- 11 posterior IC veins + subcostal vein
- Anastomose with ant IC veins
- Receives from post branch of IC vein and vertebral branch (draining vertebral plexus)

THORAX

BREASTS

Properties

- Suspensory ligaments
- 15-20 lobules per mammary gland
- Drains into ducts into sinus
- Sebaceous glands in areola

Base

- 2/3 Pectoral fascia | 1/3 Serratus Anterior
- Separated from fascia by retromammary space

Location

- 2nd to 6th ribs & Axillary process

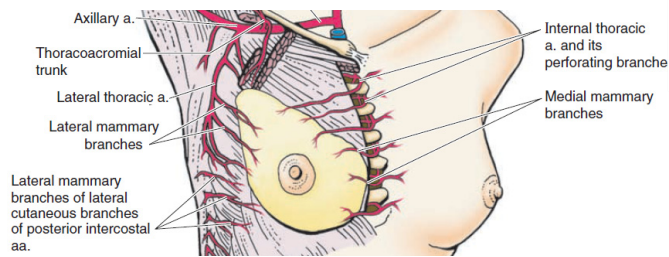
Vasculature

Arterial

Arteries	Origin
Medial Mammary	Internal Thoracic
Perforating Branches	
Anterior IC	Axillary
Lateral Thoracic	
Thoracoacromial	Thoracic Ao
Posterior IC	

Venous

- Mostly axillary
- Some to internal thoracic

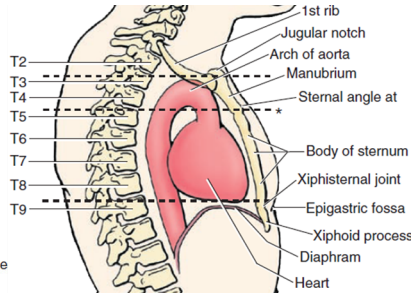


SURFACE ANATOMY

Clavicle

- Landmark for lymphatic drainage
- Above → inf jugular nodes
- Below → axillary nodes

Landmark	Body	Disc	Cartilage	Underlying Structures
Jugular Notch	T2 (inf border)			
Manubrium	T3-4 body			Arch Ao on left/SVC on right
			3 rd	SVC into RA
Sternal Angle		T4/5		
Body	T5-9 body			
Xiphisternal Jt	T9 (inf border)			

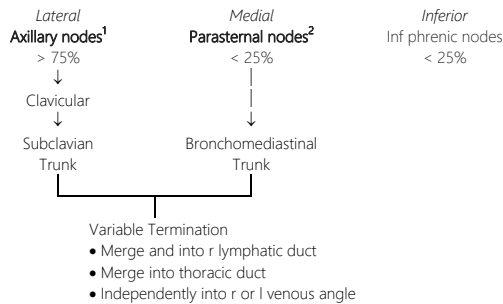


Lines	Defining Feature
AML	Middle of anterior surface
MCL	Middle of Clavicle
AAL	Inferolateral border of Pec Major
MAL	Middle of axilla
PAL	Lat dorsi & Teres Major
PML	Middle of posterior surface
SL	Inferior angle scapula

Lymphatic

Nipple, areola, Lobules (from subareolar lymphatic plexus)

Drainage area



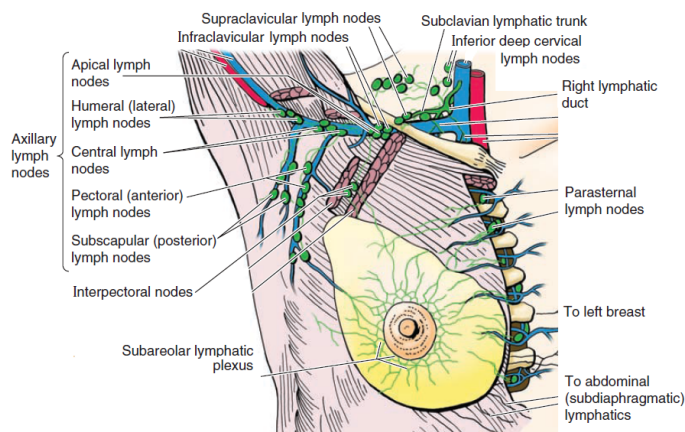
¹ From pectoral nodes or directly

Sometimes interpectoral, deltopectoral, supraclavicular, inf deep cervical

² Or opposite breast

Skin (except nipple & areola)

- Ipsilateral axillary, inferior deep cervical, infraclavicular nodes
- Bilateral parasternal nodes



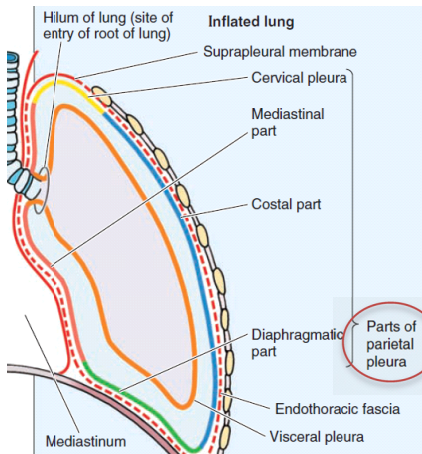
Nerves

- Ant & lateral cutaneous branched of 4th to 6th IC

THORAX

THORACIC CAVITY

Pleurae

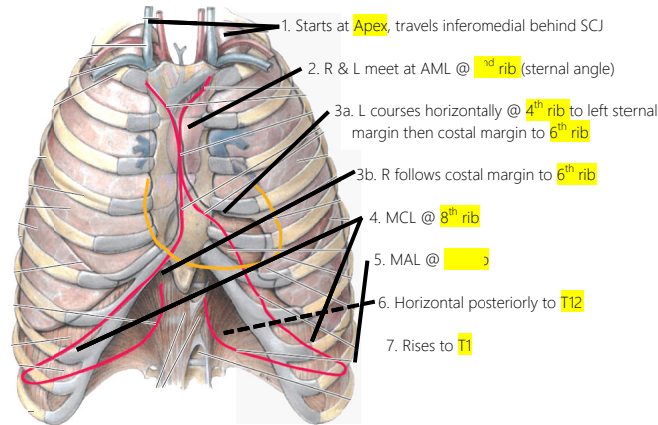


NB **endothoracic fascia** outside of parietal pleura

- Thicker at apex as **suprapleural fascia**
- Thinner at diaphragm as **transdiaphragmatic pleural fascia**

Lines of Pleural Reflection

- Sternal: costal meets mediastinal
- Costal: costal meets diaphragmatic
- Diaphragmatic:
- Vertebral: costal meets mediastinal



VASCULATURE OF LUNGS & PLEURAE

Pulmonary Arteries

- Pulmonary trunk from RV branches into R & L @ sternal angle
- **Superior lobar arteries** arise **before** entering hilum
- Posterolateral to main bronchus as it enters lung
- Becomes **L inferior lobar** and **R intermediate lobar**
- Branches with bronchial tree (usually anterior to)

Pulmonary Veins

- **Superior & inferior L & R pulmonary veins** (R middle lobe vein is tributary of R superior)
- Run indep of arteries & bronchi
- Visceral pleural and bronchial venous circulation drain into pulmonary veins
ie **deoxygenated** (not central and perihilar regions)
- Parietal pleural drains to systemic veins in thoracic wall

Bronchial Arteries

- Nutrition for lung root, visceral pleura, supportive tissue
 - Left: 2x from thoracic Ao
 - Right: 1x from R 3rd Post IC (sometimes Ao)
- Branch to upper oesophagus then travel posterior to bronchi to supply them
- Distal branches anastomose with pulmonary arteries in bronchioles

Bronchial Veins

- Drain small portion of bronchial arteries (mainly prox root)
- Drain small portion of oesophageal veins
 - R bronchial vein → azygous
 - L bronchial vein → hemiazygous or left superior IC

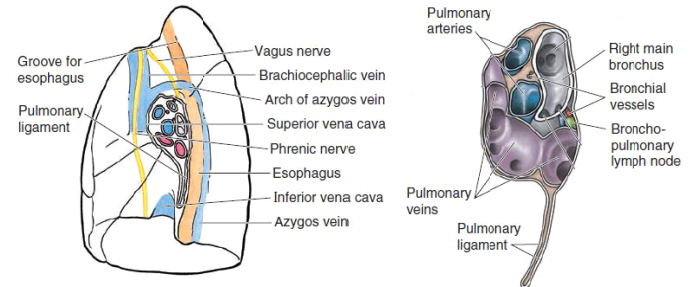
LUNG ANATOMY

Overview

- 3 surfaces: costal, mediastinal, diaphragmatic
- 3 borders: Ant, Inf, Post

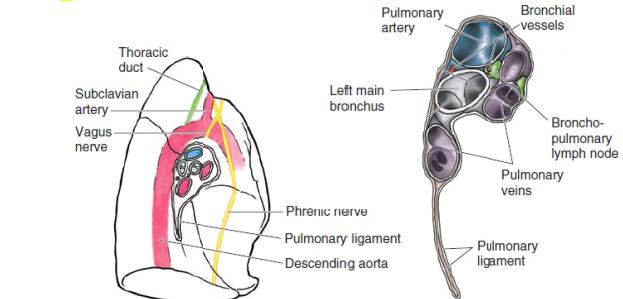
Right Lung

- Superior, Middle, Inferior lobes
- Separated by oblique and horizontal fissure



Left Lung

- Superior, Inferior lobes
- Separated by oblique fissure
- **Lingula** represents ant-inf part of sup lobe, overlies of **cardiac notch**

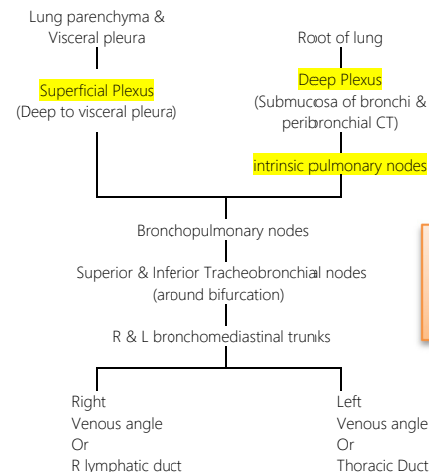


TRACHEOBRONCHIAL TREE

Generation		L	R
Trachea			
Main Bronchi	R Wider, Shorter, Vertical		
Lobar Bronchi	Supplies Lobe	2	3
Segmental Bronchi	Largest subdivision of lobe	8-10	10
	Pyramidal CT btwn each		
	indep a. supply		
Conducting Bronchioles	20-25 generations		
Terminal Bronchioles	No cartilage		
Alveolar duct	2-11 from each bronchiole		
Alveolus	5-6 from each duct		

LUNG LYMPHATICS

Pulmonary Lymphatic Plexus



NB **LLL drains to Superior Tracheobronchial nodes**. All other lobes drain as they should

THORAX

THORACIC CAVITY

LUNGS INNERVATION

Pulmonary plexus

- Anterior and posterior to root of lung

Parasympathetic

- Presynaptics from Vagus
- Synapse with ganglion in plexus & along bronchial tree
- Bronchoconstrict
- Vasodilate
- Secretomotor

Sympathetic

- Postsynaptic
- Ganglion in sympth trunk
- Bronchodilate
- Vasoconstrict
- Secretoinhibitory

Visceral Afferent

- Reflexive (para)
- Nociceptive (sympth)

Parietal Pleura

Costal	Intercostal
Diaphragmatic (other)	
Diaphragmatic (central)	Phrenic
Mediastinal	

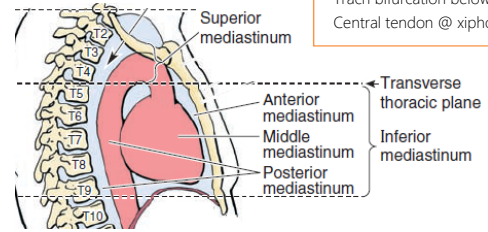
LUNG SURFACE ANATOMY

	Lungs	Parietal Pleura
MCL	6	8
MAL	8	10
SL	10	12
PV	10	12

Fissures

- Oblique: T2 → 6th costal cartilage (medial border of scapula when abducted)
- Horizontal: 4th rib & costal cartilage from oblique fissure

MEDIASTINUM



NB When Erect
Ao arch @ transverse plane
Trach bifurcation below plan
Central tendon @ xiphoid (T9/10 disc)

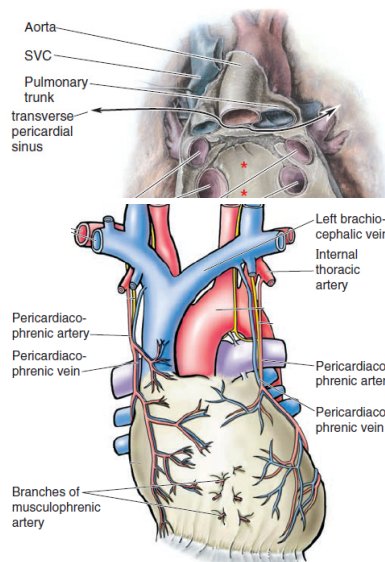
MIDDLE MEDIASTINUM

- Pericardium
- Heart
- Root of great vessels

PERICARDIUM

Layers	Fibrous	Visceral
	Outer	Inner
	Thick	Single layer of mesothelium
	Inf: Central tendon of diaphragm	Forms the epicardium
	Sup: Tunica adventitia superiorly	
	Ant: Sternoparicardial ligament ant	
	Post: loose CT of mediastinum	

Areas of Continuity	1. Ao & Pulmonary trunk exit 2. SVC & IVC enter
Structures enclosed	Up to arch of Ao All of Thoracic IVC



Pericardial Sinuses

Sinus	Transverse	Oblique
Anterior	Ao & Pulm Trunk	LA
Posterior	SVC	Oesophagus
Lateral		Pulm veins, IVC
Entry	Lateral	Inferior

Vasculature of the Pericardium

Vessel	Origin/Drainage
Arterial	
Pericardiophrenic	Int thoracic
Musculophrenic	
Bronchl, oesph, sup phrenic	Ao
Coronary Arteries	
Veins	
Pericardiophrenic	Brachicephalic
Tributaries of	Azygous

Innervation

- Phrenic (C3-5) = sensory
- Vagus ? Fcn
- Sympth trunk = vasomotor

THORAX

□ MEDIASTINUM

HEART

- 4 chambers
- **Coronary sulcus** separates A from V
- **Ant & Post IV groove** separates LV from RV

Wall: Endocardium | Myocardium | Epicardium (visceral pericardium)

Fibrous Skeleton

- R & L fibrous ring (for AV valves)
- Ao & Pulmonary coronets (for SL valves)
- Forms membranous part of IA & IV septum

Orientation	Base	Apex
	LA (some RA) T6-9 Pulm trunk → coronary sulcus	LV Left of 5 th space (9cm from AML) Motionless

Surface	Structure	Border	Structure
Ant	RV	Sup	RA/LA/Auricle
Inf	LV > RV	Inf	RV > LV
R	RA	R	RA/SVC/IVC
L	LV	L	LV > auricle

Right Atrium

- Auricle overlaps Asc Ao
- **Sinus venarum** (smooth post surface)
- **Pectinate muscle** (rough ant surface)
- **Sulcus Terminalis** (external) | Cristae Terminalis (internal) (separates smooth/rough)
- Oval fossa on IA septum

Left Atrium

- Muscular left auricle (**Pectinate muscle**)
- Remainder of atrium is smooth

Right Ventricle

- **Trabeculae carneae** lines interior
- Superiorly tapers to form **Conus arteriosus** (turns into pulm trunk)
- **Supraventricular crest** separates Trabeculae from Conus
- **Septomarginal trabeculae** inf IVS → base of ant papillary muscle (Contains R bundle branch)

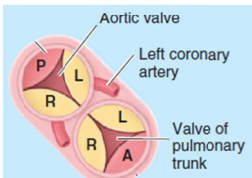
Left Ventricle

- **Trabeculae carneae** is finer & more numerous
- Superiorly tapers to form **Aortic Vestibule** (turns into Ao orifice)
- Flow 180° around ant mitral cusp
- Myocardium 2-3x thicker

	Tricuspid Valve	Mitral Valve
Cusps	Ant, Post, Septal	Ant, Post
Tendinous Cords		
Papillary Muscles	Ant: AP cusps Post: PS cusps Septal: SA cusps	Ant: AP cusps Post: PA cusps

- IVS
- Membranous part (part of fibrous skeleton)
 - Muscular part (same thickness as LV)

Semilunar Valves	Leaflets
Pulmonary	Anterior Right Left
Aortic	Right Left
	RCA LCA



- Structure
- **Lunule**: free edge of cuff
 - **Nodule**: apex of lunule
 - **Sinus** at origin of valves
 - Prevent sticking to wall of vessel
 - RCA & LCA originate in sinus

- Tricuspid = behind sternum @ 4th and 5th space
- Mitral = behind sternum @ 4th cartilage
- AV = R of sternum @ 3rd space

Conduction

Element	Location/Course/Supply
SA node	Btwn SVC & RA (near sulcus terminalis)
AV node	Post-Inf IAS (near opening of coronary sinus)
R bundle	IVS, Ant papillary muscles, RV
L bundle	IVS, Ant & Post papillary muscles, LV

VASCULATURE OF THE HEART

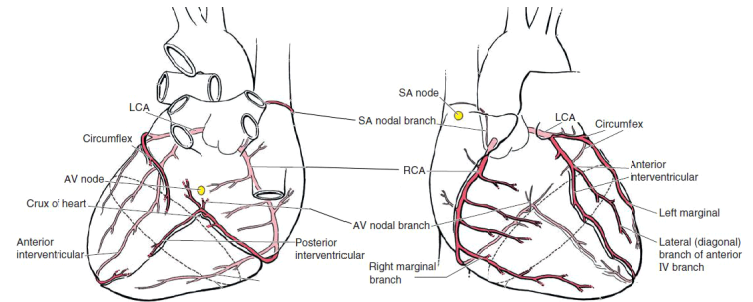
- Endocardium & subendocardium passive diffusion from chambers
- Remainder through coronary arteries (travel deep to epicardium)

Arterial Supply

Artery	Origin	Course	Distribution	Anastomosis*
RCA	R Ao sinus	Coronary sulcus	RA	LCx
SA nodal	@ Origin 60%	Behind SVC	SA, Pulm trunk	-
R marginal	@ Inf border	Inf margin ^Δ	RV, apex	IV branches
Post IV	@ Crux 67% ²	Post IV groove ^Δ	RV, LV, Post 1/3 IVS	Ant IV branches @ apex
AV nodal	@ Crux 80%	Short	AV	-
Artery	Origin	Course	Distribution	Anastomosis
LCA	L Ao sinus	AV groove	LA, LV, IVS, AV bundle	RCA
Ant IV¹	Cont of LCA	Ant IV groove ^Δ	RV, LV, Ant 2/3 IVS	Post IV branches @ apex
Lateral³	Ant IV	Ant surface	LV	
LCx	@ Inf border L auricle	Coronary sulcus	LA, LV	RCA
SA nodal	LCx 40%	Behind LA	SA, LA	-
L marginal	LCx @ lateral border	L heart border ^Δ	LV	IV branches
Post IV	@ Crux 15% ²	Same as when RCA branch		



- ¹LAD Crux =
- ²Dominance, 18% co-dominance (post IV off RCA and Ant IV is longer)
 - ³of Ant IV artery (aka diagonal)
 - ^ΔTo apex of heart
 - *10% have anastomosis, rest have potential

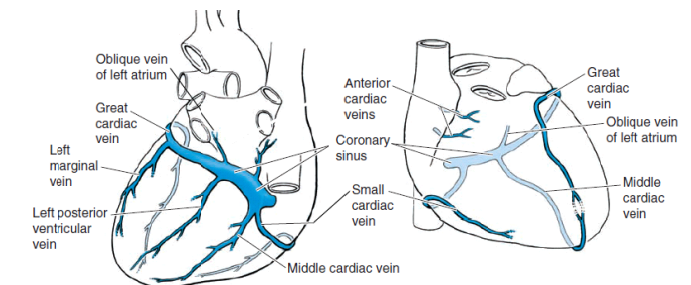


Venous Drainage

- Coronary sinus or small veins directly into RA
- Anterior interventricular vein →

Vein	Drainage	Course	Distribution
Great cardiac vein	Coronary Sinus	LCx	LCA supply
Anterior IV	Great Cardiac	Ant IV artery	
Middle Cardiac¹		Post IV artery	
Small Cardiac¹	Coronary Sinus	R marginal artery	RCA supply
Oblique vein of LA²			LA
Anterior cardiac veins	RA	RV/RA	

- ¹Near origin of carotid sinus
²Insignificant postnatally, defines transition from great cardiac to coronary sinus



Lymphatics

- **Subpericardial lymphatic plexus** → **tracheobronchial nodes** (right side btwn Pulm trunk & LA)

Innervation

- **Cardiac plexus** located post to Asc Ao & Pulmonary trunk

Parasympathetic	Sympathetic	Sympathetic
• Presynaptics from Vagus	• Presynaptic	• Postsynaptic
• Synapse with ganglion in Atria & IAS	• Ganglion in IML T1-6	• Ganglion in C/T symp trunk
• Negative ¹	• Positive ¹	• Positive ¹

¹Inotropy, Chronotropy, Dromotropy

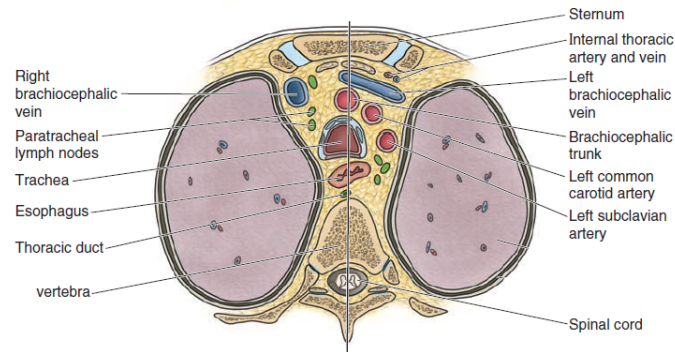
THORAX

MEDIASTINUM

SUPERIOR MEDIASTINUM

Anterior to Posterior

1. Thymus
2. Veins: brachiocephalics (SVC lower down)
3. Arteries: Asc Ao, Arch and branches (BC, Common carotids)
4. Nerves: Vagus & Phrenic
5. Trachea
6. Oesophagus
7. Thoracic Duct



THYMUS

- Arterial: ant IC & ant mediastinal branches of Internal Thoracic
- Venous: L brachiocephalic
- Lymphatics: parasternal, brachiocephalic, tracheobronchial nodes

GREAT VESSELS

Venous

Level	Structure	Drainage
Above SCJ	IJ & SC veins	Head, Neck, Right Upper Limb
SCJ	L ¹ & R Brachiocephalic veins	
Inf border 1 st right cartilage	SVC	Everything above diaphragm ²
3 rd right cartilage	SVC enters RA ³	

¹passes anterior to root of Ao branches

²Except heart & lungs

³Ant to trachea, Posterolateral to Asc Ao, Phrenic nerve on medial wall

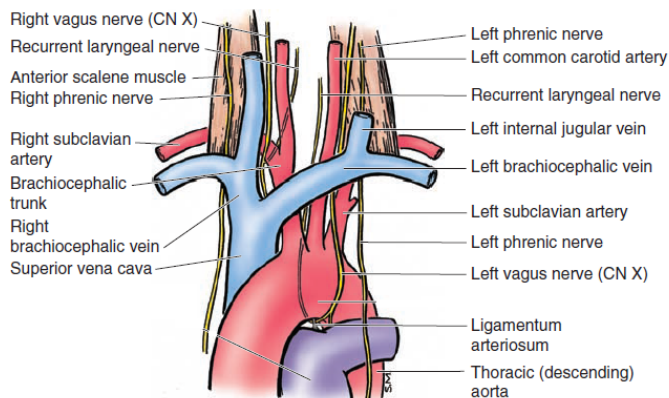
Arterial (Arch of Ao)

Level	Structure	Surrounds
R of sternal angle	Arch Ao starts	
	Ascending part	Ant to R pulm a & trach bifurcation
	Apex	Left side of trach & oesph
T4	Descending part	Over and post to root of left lung

NB since Asc Ao is in pericardium, considered part of middle mediastinum

Arterial (Branches of Arch Ao)

Level	Branch	Surrounds
Post to Manubrium	Brachiocephalic trunk	Ant to trachea Post to L brachiocephalic vein
R SCJ	Divides into R SC & R CC	Trachea on left
Post/Left BC trunk	L CC	Ant to L SC
	L SC	Ant then left of trachea Post to LCC Lateral to trachea



NERVES

Vagus

- Exit neck Posterolateral to common carotid
- Enter superior mediastinum posterior to SCJ and brachiocephalic veins

Descent	Right	Left
Into Sup Mediastinum	Ant over SC artery	Descends Post to LCC
Recurrent Laryngeal Branch	Loops under R SC	Loops under arch Ao (lateral to ligamentum arteriosum)
Into Inferior Mediastinum	Ascends btwn trachea & oesophagus on r side	
	<ul style="list-style-type: none"> • Forms R pulmonary plexus • Leaves plexus as single nerve to oesophagus • Forms Oesophageal plexus 	

Phrenic Nerve

- Motor and sensory (1/3) to diaphragm
- Sensory to pericardium and mediastinal pleura

Descent	Right	Left
Into Sup Mediastinum	Btwn R SC artery & R BC vein	Btwn LCC & LSC
Into Inferior Mediastinum	Anterior to Root R side of BC vein, SVC, RA, IVC	Anterior to Root Ant to left Sup IC vein
Diaphragm	Pierces near caval opening	Pierces left of pericardium

TRACHEA

- Anterior to oesophagus
- Slightly right as it enters superior thoracic aperture
- Bifurcates at sternal angle

OESOPHAGUS

- On vertebrae T1-4 veering left as it approaches **Ao arch**
- Centres due to Ao arch (with **thoracic duct** lateral to oesophagus)
- Descends **behind root of left lung**
- Displaced to right by thoracic Ao but travels anterior to it
- Enters diaphragm at **oesophageal hiatus @ T10**

3 impressions (narrowing)

1. Ao arch
2. L main bronchus
3. Diaphragm

THORAX

□ MEDIASTINUM

POSTERIOR MEDIASTINUM

- T5-12

Posterior to Anterior

- Oesophagus & nerve plexus
- Thoracic Duct
- Thoracic Ao
- Posterior mediastinal nodes
- Veins: azygous & hemiazygous

Thoracic Ao

- Starts left of inf border T4
- Descends T5-12 posterior to root of L lung, oesophagus, pericardium
- Enters diaphragm through **Ao hiatus** @ inf border T12 (with **thoracic duct & azygous vein**)

Branches

- Described as 3 vascular plains in thoracic and abdominal Ao

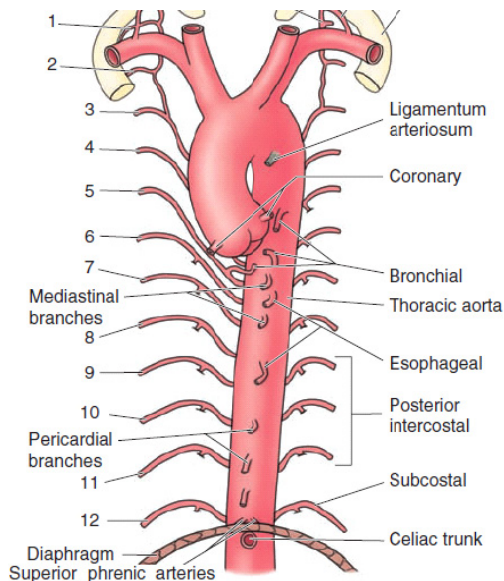
- Anterior (midline, unpaired)
 - Supplies gut
 - Oesophageal arteries (2 to 5)

Exceptions

- Superior phrenic = paired anterior branches just above the diaphragm
- Pericardial & mediastinal arteries (supply nodes and CT) = unpaired anterior

- Lateral (paired)
 - Supplies viscera other than gut (eg lungs, kidney)
 - Bronchial arteries (left, sometimes right)
 - R usually from 3rd R post IC artery

- Posterolateral (paired)
 - Supplies body wall
 - Posterior IC arteries x9 (ie not 1st or 2nd space)



Thoracic Duct & lymphatics

- Drains all but RUQ of body

Level	Surrounds
Intra-abdominal	Chyle Cistern
Diaphragm (T12)	Enters through Ao hiatus
Posterior Mediastinum	Ascends btwn Ao (L), Az (R), Oesph (Ant)
Superior Mediastinum (T4,5 or 6)	Enters L venous angle (sometimes L Subclavian)

VESSELS & NODES

Posterior Mediastinal Nodes

- From oesophagus, posterior pericardium, diaphragm, middle posterior IC spaces
- Drain into R lymphatic duct or thoracic duct

Azygous system

- Drains back, thoracoabdominal wall, mediastinal viscera, vertebral plexus
- Collateral system between IVC and SVC

Azygous

- Ascends on R side of T12→T4
- Arches ant → post over R root to SVC

Hemiazygous

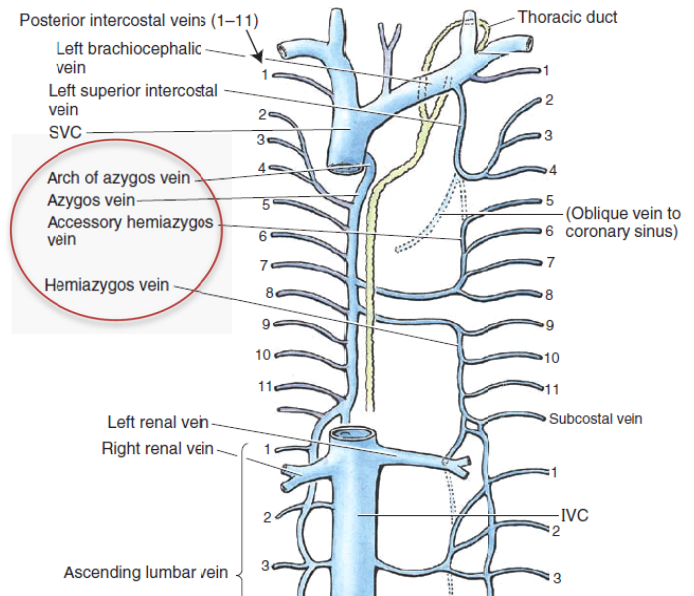
- Cont of asc lumbar veins and 9-11 + subcostal veins
- Travels on left border of T12→T9
- Then joins azygous by going post to Ao, Thoracic duct, oesophagus

Accessory Hemiazygous

- Travels on left border of T5→T8
- Then joins azygous by going post to Ao, Thoracic duct, oesophagus
- Frequently joined to superior intercostal vein
- Sometimes joins to hemiazygous

Superior Intercostal Vein

- Drains Left IC veins 1-4
- Drains into L brachiocephalic (even if joins accessory hemiazygous)



Nerves of Posterior Mediastinum

- Thoracic sympathetic trunks** are main supply
- Location changes down mediastinum
 - Superior thorax: head of ribs
 - Mid thorax: Costovertebral joints
 - Inferior thorax: sides of vertebral bodies
- NB splanchnic nerves supply below diaphragm but ganglia from T5-12

ANTERIOR MEDIASTINUM

- Thymus
- Loos CT
- Fat
- Lymphatic vessels, nodes

SURFACE ANATOMY

