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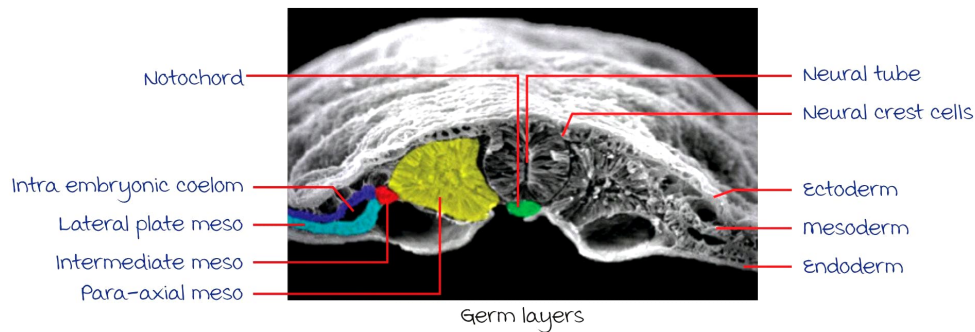
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EMBRYOLOGY

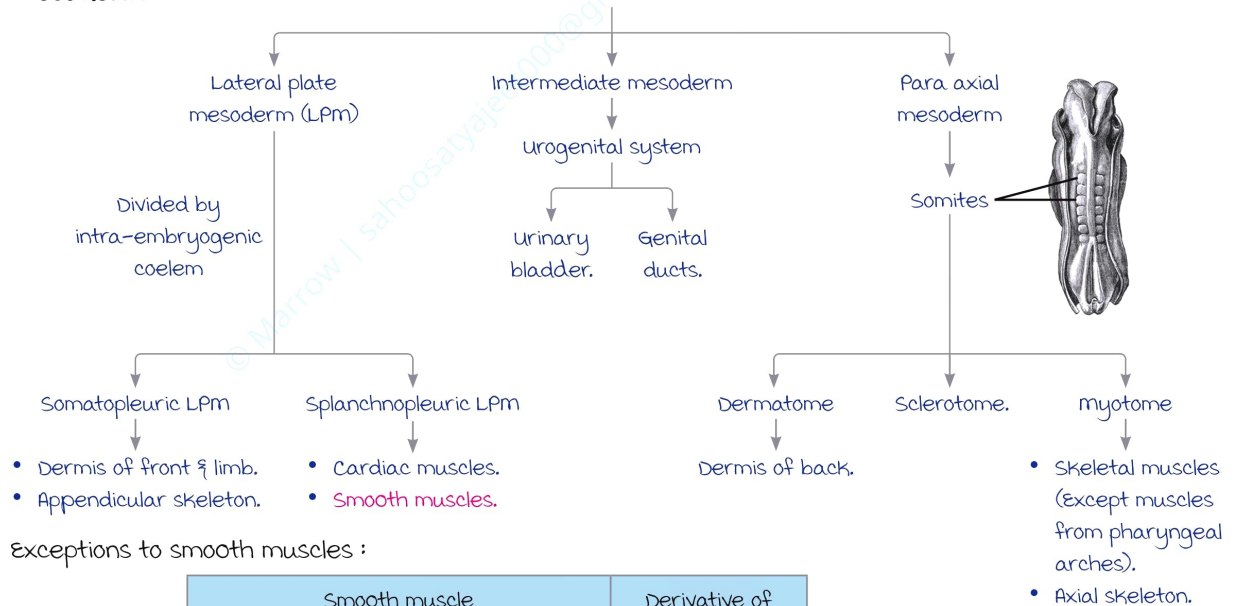
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Development of Germ Layers

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mesoderm :



Exceptions to smooth muscles :

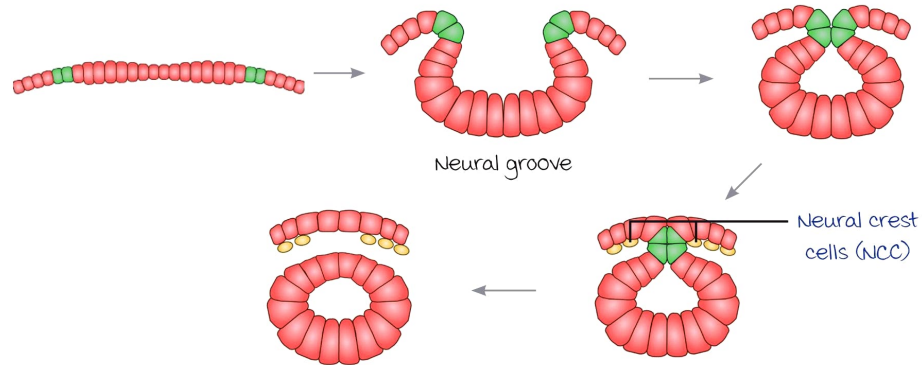
Smooth muscle	Derivative of
- Smooth muscles of ascending aorta, pulmonary trunk, coronary artery - Ciliaris muscle	Neural crest cells
- Sweat gland - Mammary gland	Ectoderm
Sphincter & dilator pupillae	Neuroectoderm

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Neural Tube :

Formation :

Formed by stimulation of ectoderm by notochord.



Remnants of notochord :

1. Apical ligament of dens.
2. **Nucleus pulposus** (Central part of intervertebral disc).
3. Tectorial membrane (Continuation of posterior longitudinal ligament).

Derivatives :

Forms CNS structures :

- Brain & spinal cord.
- Oligodendrocytes (myelination).
- Astrocytes (Blood brain barrier).
- Ependymal cells (Lining of ventricles).
- Retina & pigment.

Note :

Intervertebral disc : 2 parts.

- Outer : Annulus fibrosus.
- Central : Nucleus pulposus.

Neural Crest Cells (NCC) :

Present at the junction of neural tube & ectoderm.

Structures formed

PNS structures :

- All ganglion.
- Enteric plexus.
- Schwann cells.
- Adrenal medulla.
- Para-follicular-C cells.
- melanoblast/cyte.

Derivatives of head & neck :

- Skull bones (most).
- Dentine (Odontoblasts).
- Pharyngeal arch cartilage.
- Dermis of head & neck.
- Conotruncal septum.

Note : Adrenal cortex → Derivative of intermediate mesoderm.

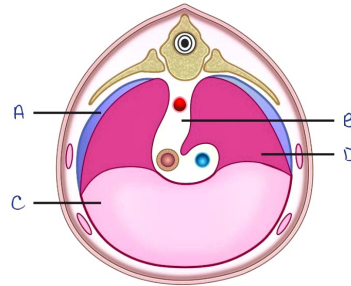
Development of Diaphragm

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Derivatives :

	Structure	Derivative
A	Body wall mesoderm/ cervical somites	muscles of diaphragm
B	Dorsal mesentery of esophagus	Crus of diaphragm
C	Septum transversum	Central tendon
D	Pleuroperitoneal membrane	Incorporated by muscles



Applied Anatomy :

Congenital diaphragmatic hernia :

- Occurs d/t absence of pleuroperitoneal membrane

Persistence of pleuroperitoneal canal (Bochdalek foramen)

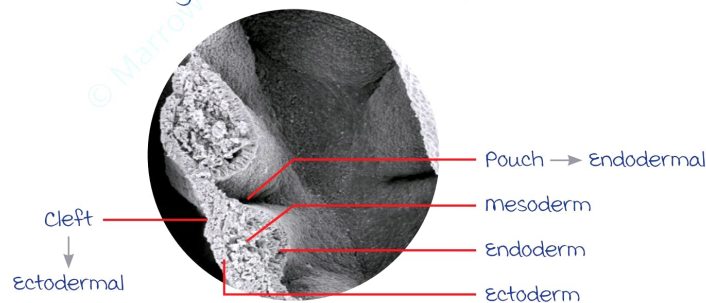
Intestinal herniation.

- Left > Right.
- Complication : Lung hypoplasia.

Pharyngeal Arches

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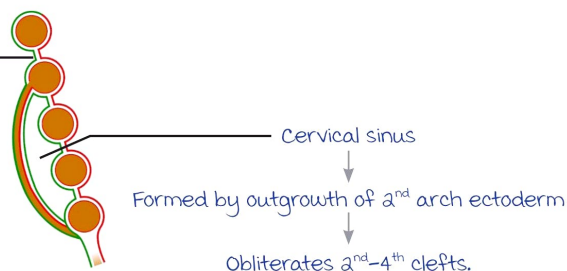
Core of mesoderm, lined by ectoderm on one side & endoderm on the other.



Pharyngeal Clefts :

1st cleft :

- Only cleft that persists.
- Derivatives :
 - External auditory canal.
 - Outer layer of tympanic membrane.



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Applied anatomy :

Persistence of cervical sinus → Branchial cyst : Swelling along sternocleidomastoid.



Pharyngeal Pouches :

Pouch	Derivatives
1	• Inner layer of tympanic membrane • Tympanic cavity • Auditory tube/eustachian tube • mastoid antrum
2	• Palatine tonsil
3	• Thymus • Inferior parathyroid
4	• Superior parathyroid
Remnant of 5 th pouch	• ultimobranchial body

Note :

C-cells : Derived from NCC > ultimobranchial body.

Applied anatomy :

DiGeorge syndrome :

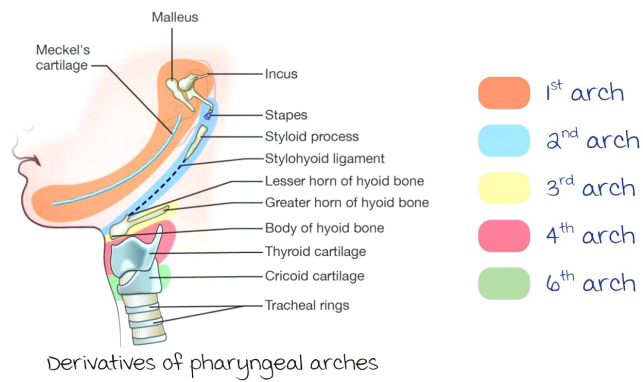
- Anomaly of 3rd > 4th pouch.
- m/c micro-deletion syndrome : 22q11 deletion.
- Absent thymus & hypoparathyroidism.



DiGeorge syndrome

Pharyngeal Arch Cartilages

Arch	Derivative structures
1	• meckel's cartilage → malleus & incus • mandible
2	• Stapes (Except footplate : Derived from otic capsule) • Styloid process • Stylohyoid ligament • Lesser cornua of hyoid
3	• Greater cornua of hyoid • Body of hyoid
4 & 6	• Laryngeal cartilages

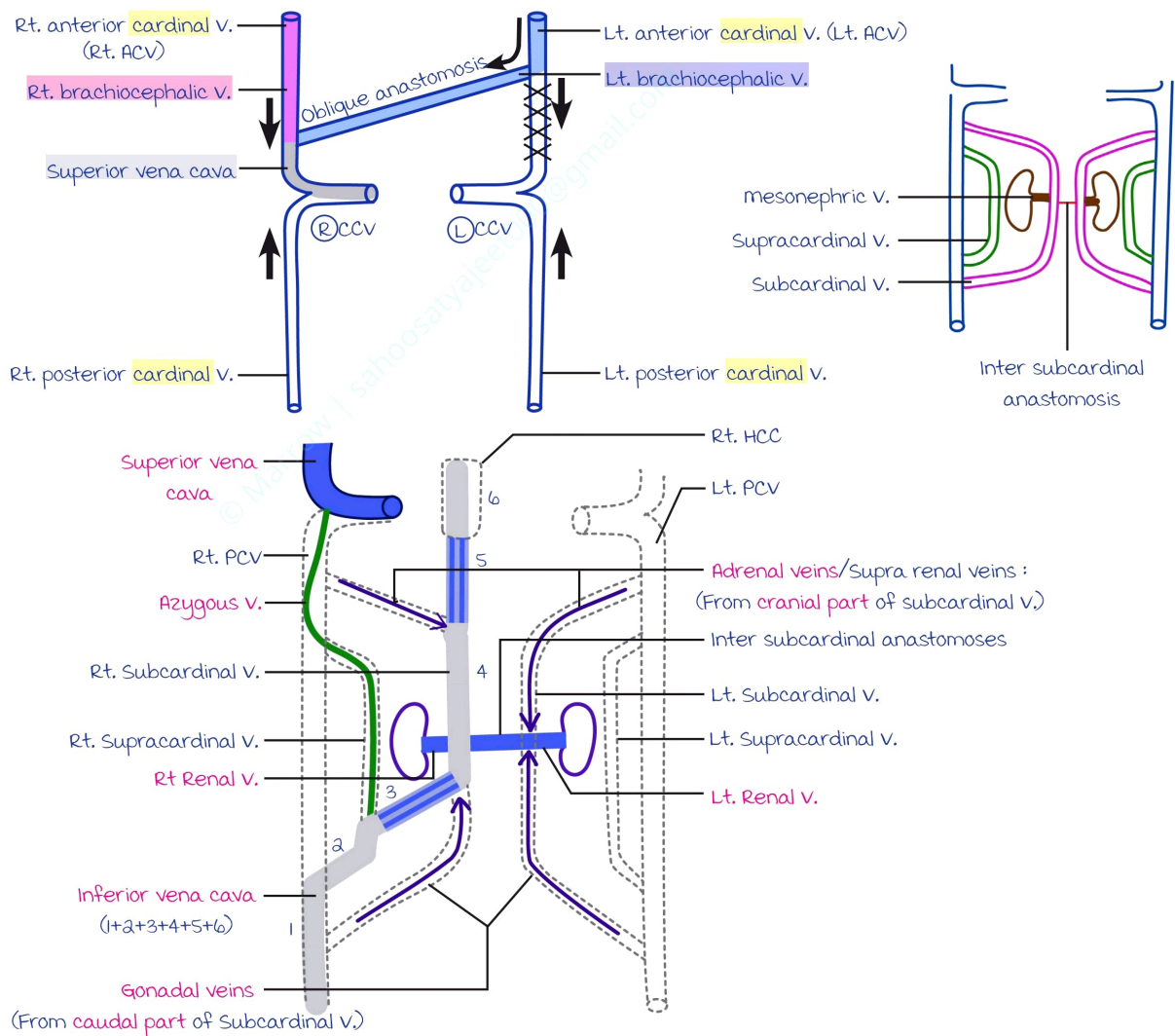


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Arterial & Venous Development

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VENOUS DEVELOPMENT



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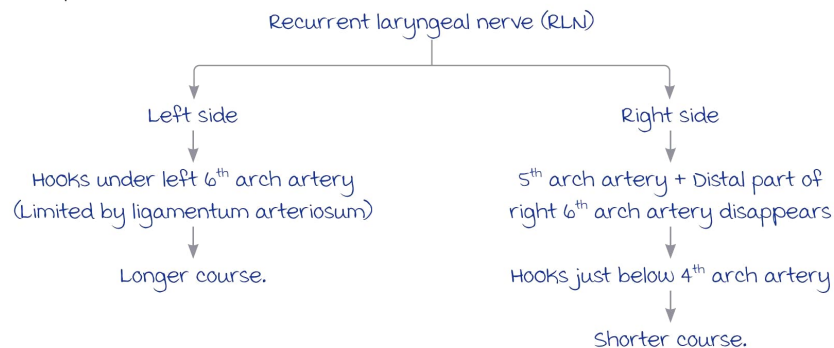
Vein		Derivative of
Rt. brachiocephalic vein		Right ACV
Lt. brachiocephalic vein		Left ACV + Oblique anastomosis
Superior vena cava		Right ACV + Right CCV
Inferior vena cava		Right PCV
		Right supracardinal
		↕ ⊕ Anastomosis
		Right subcardinal
Renal vein	Right	Right mesonephric vein
	Left	Left mesonephric vein + Intersubcardinal anastomosis
Azygos vein		Right supracardinal vein > Right PCV
Gonadal vein		Caudal part of subcardinal vein
Adrenal vein		Cranial part of subcardinal vein

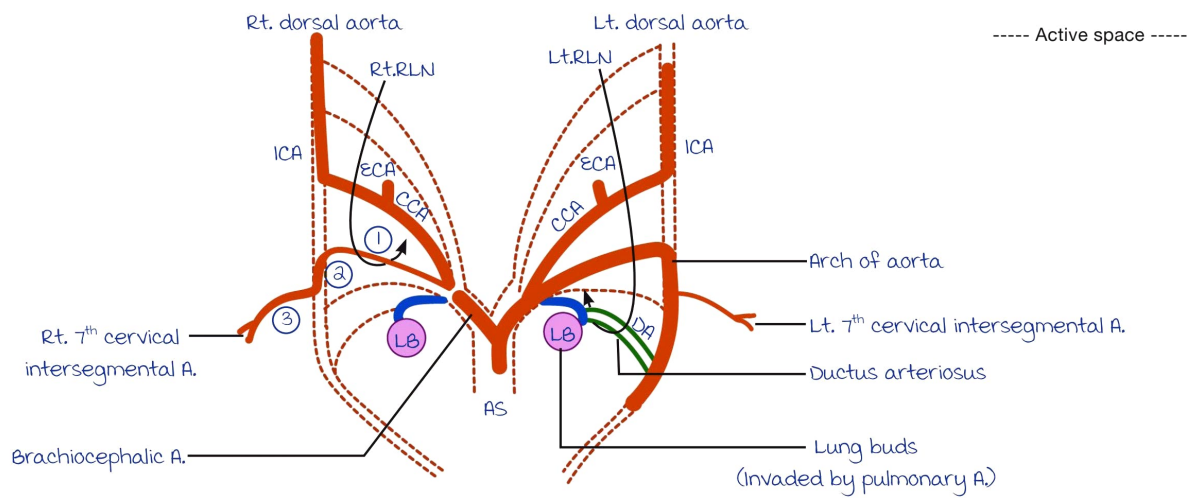
PHARYNGEAL ARCH ARTERIES

Connect the developing heart in the front to the 2 dorsal aorta.

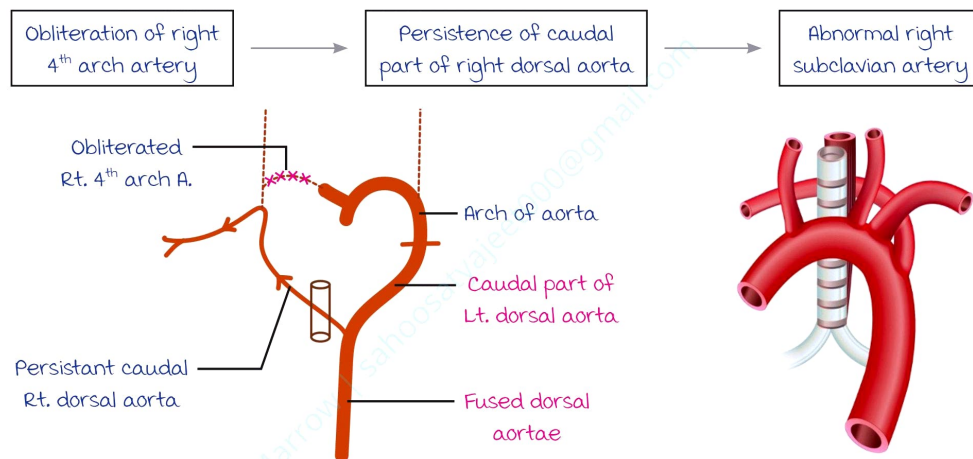
Structure		Arch artery
Arch of aorta		- Aortic sac - Left horn of aortic sac - Left 4th arch artery
Brachiocephalic trunk		Right horn of aortic sac
CCA		Proximal part of 3 rd arch artery
ICA		Distal part of 3 rd arch artery
Subclavian artery	Left	Left 7 th cervical intersegmental artery
	Right	- Right 4th arch artery - Right 7th cervical intersegmental artery
Pulmonary artery		Proximal part of 6 th arch artery
Ductus arteriosus		Distal part of 6 th arch artery

Applied aspect :





Dysphagia lusoria :



Double aortic arch : Persistence of both sides.

- 4th arch arteries &
- Dorsal aorta.

Arterial Derivatives :

Aortic arch	Derivatives
1 st arch	maxillary artery
2 nd arch	Hyoid & stapedial artery
3 rd arch	CCA & proximal ICA
4 th arch	Left : Arch of aorta Right : Part of right subclavian
5 th arch	Degenerates
6 th arch	Left : Proximal left pulmonary artery; distal ductus arteriosus Right : Right pulmonary artery

Mesogastrium & Derivatives

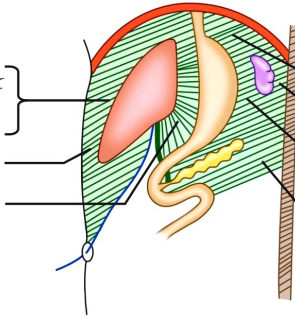
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Ventral mesogastrium :

1. Triangular ligament
2. Coronary ligament
3. Falciform ligament
4. Lesser omentum

Dorsal mesogastrium :

1. Gastrophrenic ligament
2. Lienorenal ligament
3. Gastrosplenic ligament
4. Greater omentum

**Midgut :**

Anomalies :

Anomaly	Defect in rotation	Features
Non-rotation 	Herniation followed by arrest after 1 st rotation	• Small intestine on right side. • Large intestine on left side.
Reverse rotation 	Herniation + normal 1 st rotation followed by reverse rotation	Transverse colon overlapped by SMA & small intestine
mixed rotation 	Absent 3 rd rotation	Subpyloric caecum held by Ladd Band → Compresses small intestine
Incomplete rotation 	Incomplete 3 rd rotation	Subhepatic caecum