

VISCERAL ANATOMY OF THE HEAD AND NECK:

ORAL CAVITY. TEETH.

BOUNDARIES OF THE ORAL CAVITY	
VESTIBULE	<p>Entry: oral fissure</p> <p>Anteriorly: lips (frenulum); laterally: cheeks (buccinator); medially: alveolar arch, teeth and gums (gingivodental arches)</p>
ORAL CAVITY PROPER	<p>ANTERO-LATERAL</p> <p>Alveolar arch, teeth and gums (gingivodental arches)</p>
	<p>FLOOR</p> <p>Anterior portion of the tongue, up from the lingual V.</p> <p>At the front and on the sides, between the base of the tongue and the medial surface of the mandible, mucosa over the mylohyoid and geniohyoid muscles. Frenulum of tongue, caruncles and sublingual folds (sublingual gland+ submandibular duct)</p>
	<p>ROOF</p> <p>Hard palate (opposite: maxilla, palatine process; behind: palatine horizontal plate).</p> <p>Soft palate:</p> <ul style="list-style-type: none"> • Reinforced by the palatine aponeurosis (attached to the hard palate and the pterygoid hamulus). • Pterygoid hamulus marks a protrusion (start of the pterygomandibular raphe fold). • Ends posteriorly in the uvula. • Contains the PALATINE MUSCLES: tensor veli palatini, levator veli palatini, palatoglossus, palatopharyngeus, musculus uvulae.
	<p>BEHIND: OROPHARYNGEAL ISTHMUS OR OF THE FAUCES</p> <ul style="list-style-type: none"> • Above: uvula and soft palate. • Below: back of the tongue. • Laterally: ARCHES or SOFT PALATE PILLARS. <ul style="list-style-type: none"> ➢ anterior: palatoglossus muscle. ➢ posterior: palatopharyngeus muscle. ➢ Between them: palatine or tonsillar fossa with the palatine tonsil.

TEETH ANATOMY

INCISOR: one root, no cusps (incisal edge)

CANINE: one root, one cusp

PREMOLAR (bicuspid): inferior ones and the second superior premolar, one root. First superior, two roots.

SUPERIOR MOLAR: four or five cusps, three roots, which may be fused (mostly at the third molar).

INFERIOR MOLAR: four or five cusps, two roots, which may be fused (mostly at the third molar).

VISCERAL ANATOMY OF THE HEAD AND NECK:

**LINGUAL MUSCLES.
HYPOGLOSSAL NERVE.**

	MUSCLE	INSERTION	INSERTION	FUNCTION
I N T R I N S I C	SUPERIOR LONGITUDINAL	It is the only UNEVEN one. Underlying to the mucosa of the dorsum of the tongue. It goes from the lesser cornu of the hyoid and epiglottis to the tip of the tongue.		It shortens the tongue. It lifts the tip (concave dorsum). It predominates over the inferior longitudinal.
	INFERIOR LONGITUDINAL	Next to the inferior lingual surface. It goes from the lesser cornu of the hyoid to the tip, between the genioglossus and the hyoglossus.		It shortens the tongue. It runs down the tip (convex dorsum).
	TRANSVERSUS	Intermingled with fibres from the rest of the muscles, their fibres arise from the lingual septum to the tip of the tongue.		It narrows and spreads the tongue out.
	VERTICALIS	Vertical fibres between both lingual surfaces in the anterior part of the tongue.		It flattens and widens the tongue.
E X T R I N S I C	GENIOGLOSSUS	Superior genial process	It opens up in fan-shape backwards and upward, forming a C; it ends in the hyoid and hyoglossal membrane (inferior fibres), posterior portion of the tongue (intermediate fibres) and along the ventral surface of the tongue (superior fibres).	Forward traction of the tongue (take it out the mouth). When only one side acts, the tongue deflects to the CONTRALATERAL side. Acting bilaterally: it depresses the tongue, making it concave from side to side.
	HYOGLOSSUS	Body and greater cornu of the hyoid	a quadrilateral and vertical sheet which enters the tongue laterally, between the inferior longitudinal and the styloglossus.	It depresses and brings posteriorly the base of the tongue.
	STYLOGLOSSUS	Styloid process	Under the palatoglossus, in the most lateral part of the tongue.	It draws the tongue upwards and backwards.
	PALATOGLOSSUS	Palatine aponeurosis	Small fascicle going down towards the lateral side of the base of the tongue.	It lifts the root of the tongue. It approaches the anterior pillars of the soft palate closing the isthmus of the fauces.
	It forms the anterior pillar of the soft palate. Innervated by fibres of the pharyngeal plexus (glossopharyngeal + vagus)			
	GENIOHYOID	Inferior genial process	Superior to the mylohyoid, it goes to the body of the hyoid.	It lifts and pulls forward the hyoid / it makes the jaw descend.

LINGUAL ARTERY

It runs medial to the hyoglossus, to the inferior surface of the tongue.

- **Suprahyoid.** It follows the superior border of the hyoid and anastomoses with the contralateral.
- **Dorsal lingual branches.** They irrigate the dorsum of the tongue, the anterior arch of the soft palate and the epiglottis.
- **Sublingual.** It irrigates the sublingual gland, the mylohyoid muscle, the oral mucosa and the gums. It has **mental** branches, which pass through the mylohyoid muscle.
- **Deep lingual or ranine artery.** The terminal branch of the lingual artery, after giving off the sublingual. It runs to the vertex of the tongue. It irrigates the lingual muscles.

LINGUAL VEIN

It is formed from the union of the dorsal lingual and deep lingual veins and the vena comitans of the hypoglossal nerve. Tributaries:

- **Sublingual.** From the sublingual salivary gland. It joins the deep lingual vein to form the vena comitans of the hypoglossal nerve.
- **Dorsal lingual veins.** They drain the dorsum and sides of the tongue and join the lingual veins accompanying the lingual artery medial to the hyoglossus muscle.
- **Deep lingual vein.** It begins near the tip of the tongue and runs back just beneath the mucous membrane on the inferior surface of the tongue (IMPORTANT FOR THE ABSORPTION OF MEDICATION) . It joins the sublingual to form the...
- **Vena comitans nervi hypoglossi,** which runs backward with the hypoglossal nerve lateral to the hyoglossus to join the lingual vein.

Author:
Daniel Sánchez Zuriaga
 (Universitat de València)

VISCERAL ANATOMY OF THE HEAD AND NECK:

SALIVARY GLANDS

PAROTID GLAND: RELATIONS (parotid cell)

ABOVE	External Auditory Canal. Temporomandibular joint.
LATERAL (in surface)	Skin and superficial fascia with cutaneous nervous branches and most posterior fibres of the platysma muscle.
ANTERIOR AND MEDIAL	From surface to depth: masseter, mandibular ramus and medial pterygoid. The facial nerve branches exiting towards the face from the anterior edge. The parotid duct or duct of Stenon also emerges from the anterior edge.
POSTERIOR AND MEDIAL	Mastoid process, sternocleidomastoid muscle, styloid process and their muscles. The external carotid artery enters the gland through this surface.
BELOW	Submandibular gland
CONTENTS	A fibrocellular plane divides it into two lobes (superficial and deep). Between them, the facial nerve, the retromandibular vein and the external jugular vein.

SUBMANDIBULAR GLAND: RELATIONS (submandibular cell)

ABOVE AND LATERAL	Medial surface of the mandible.
BELOW AND LATERAL (in surface)	Skin and superficial fascia with most posterior fibres of the platysma muscle.
ABOVE AND MEDIAL	Digastric and mylohyoid muscles.
DEEP PORTION	Above/medial to the mylohyoid muscle, lateral to the hyoglossus muscle, it runs to the back side of the sublingual gland.
EXCRETORY DUCT	It is the submandibular duct or Wharton's duct. It arises from the medial surface, at the level of the mylohyoid posterior edge, and traverses the deep portion. It runs between the sublingual gland (along with it, it forms the sublingual fold in the floor of the mouth) and the genioglossus muscle until it drains in the sublingual caruncle. The lingual nerve passes below Wharton's duct and follows the deep portion and the sublingual gland.

SUBLINGUAL GLAND: RELATIONS

ABOVE	Floor of the mouth mucosa (sublingual fold)
BELOW	Mylohyoid muscle
ANTERIOR	They connect with the gland of the other side.
LATERAL	Mandible
MEDIAL	Submandibular duct and genioglossus muscle
EXCRETORY DUCTS	From 8 to 20. They drain along the sublingual fold.

Author:

SENSITIVE INNERVATION OF THE SALIVARY GLANDS:

General sensory innervation to the parotid gland, its sheath, and the overlying skin provided by the **great auricular nerve** and some fibres of the auriculotemporal nerve.

Submandibular and sublingual are innervated by the lingual nerve.

(Universitat de València)

Author:

AUTONOMIC NERVOUS SYSTEM General overview and cranial nerves

(Universitat de València)

PARASYMPATHETIC INNERVATION OF THE PAROTID GLAND:

- INFERIOR SALIVATORY NUCLEUS

- Glossopharyngeal nerve

- Tympanic (Jacobson) nerve
 - ↳ tympanic (Jacobson) duct

- Tympanic plexus

- LESSER PETROSAL NERVE

- ↳ exit to the endocranium by the lesser petrosal foramen
- ↳ exit to the exocranium by foramen ovale, lacerum or petrosal

- OTIC GANGLION (close to the exocranial side of the foramen ovale)

- Auriculotemporal nerve (3rd branch of the trigeminal nerve, mandibular)

SYMPATHETIC INNERVATION OF THE PAROTID GLAND:

- From the superior cervical ganglion, by means of the plexuses along the external carotid branches.

PARASYMPATHETIC FIBRES FROM THE SUPERIOR SALIVATORY NUCLEUS: always with the FACIAL nerve

- LACRIMO-MUCO-NASAL PATHWAY

- GREATER PETROSAL NERVE (from the geniculate ganglion)

- ↳ It exits to the endocranium through the greater petrosal foramen

- ↳ Close to its exit from the endocranium, it meets the DEEP PETROSAL nerve, with sympathetic fibres from the internal carotid plexus.

- ↳ Just before or after their fusion, both pass through the FORAMEN LACERUM.

- Greater petrosal + deep petrosal = nerve of the PTERYGOID CANAL or VIDIAN NERVE

- ↳ enters the PTERYGOID or VIDIAN CANAL, through the base of the pterygoid process

- ↳ reaches the PTERYGOPALATINE FOSSA

... and gets to the PTERYGOPALATINE GANGLION (in the pterygopalatine fossa)

PTERYGOPALATINE GANGLION (in the pterygopalatine fossa)

- Zygomatic nerve (from the 2nd branch of the trigeminal nerve, maxillary)
 - ↳ It enters the orbit through the INFERIOR ORBITARY FISSURE.
 - ↳ Its ZYGOMATICOTEMPORAL branch sends branches to the LACRIMAL nerve (from the 1st branch of the trigeminal nerve, ophthalmic).
 - ↳ And they arrive to the LACRIMAL GLAND.
- Nasopalatine and nasal nerves (from the 2nd branch of the trigeminal nerve, maxillary)
 - ↳ through the SPHENOPALATINE foramen
 - ↳ to the NASAL mucosa (and through the INCISIVE foramen, the anterior part of the palate).
- Greater and lesser palatine nerves (from the 2nd branch of the trigeminal nerve, maxillary)
 - ↳ through the PALATINE foramina, greater and lesser,
 - ↳ to the PALATINE mucosa.

PARASYMPATHETIC FIBRES FROM THE SUPERIOR SALIVATORY NUCLEUS: always with the FACIAL nerve.

•SUBMANDIBULAR PATHWAY

- CHORDA TYMPANI nerve
 - ↳ It reaches the exocranium through the PETROTYMPANIC FISSURE.
- LINGUAL nerve (from the 3rd branch of the trigeminal nerve, mandibular).

... and it gets to the SUBMANDIBULAR GANGLION (superior to the deep portion of the submandibular gland) to innervate the SUBMANDIBULAR and SUBLINGUAL GLANDS.

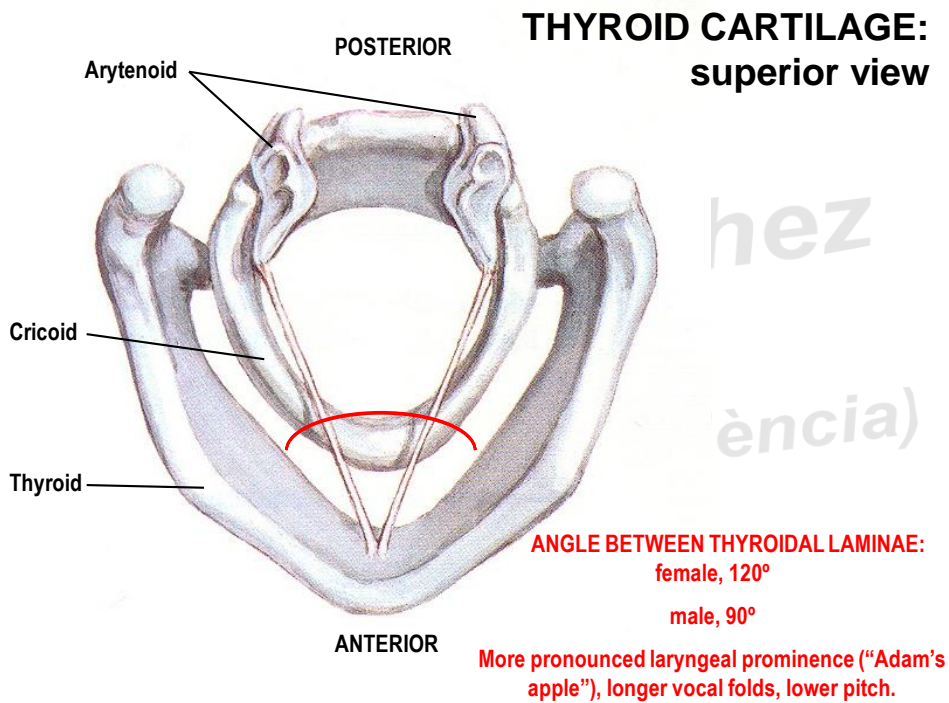
SYMPATHETIC fibres get to these glands from the plexus of the LINGUAL or FACIAL artery (following the arterial supply of the glands).

VISCERAL ANATOMY OF THE HEAD
AND NECK:

**LARYNX. LARYNGEAL
CARTILAGES, JOINTS,
LIGAMENTS, MUSCLES AND
INNER CONFIGURATION.
THYROID GLAND.**

LARYNX: first portion of
the respiratory airways

- air conduit
- sphincteric area
- voice production



CRICOTHYROID JOINT

Rotation around a transverse axis and gliding of thyroid over cricoid.

CRICOARYTENOID JOINT

Rotation of the arytenoids around an approximately vertical axis.

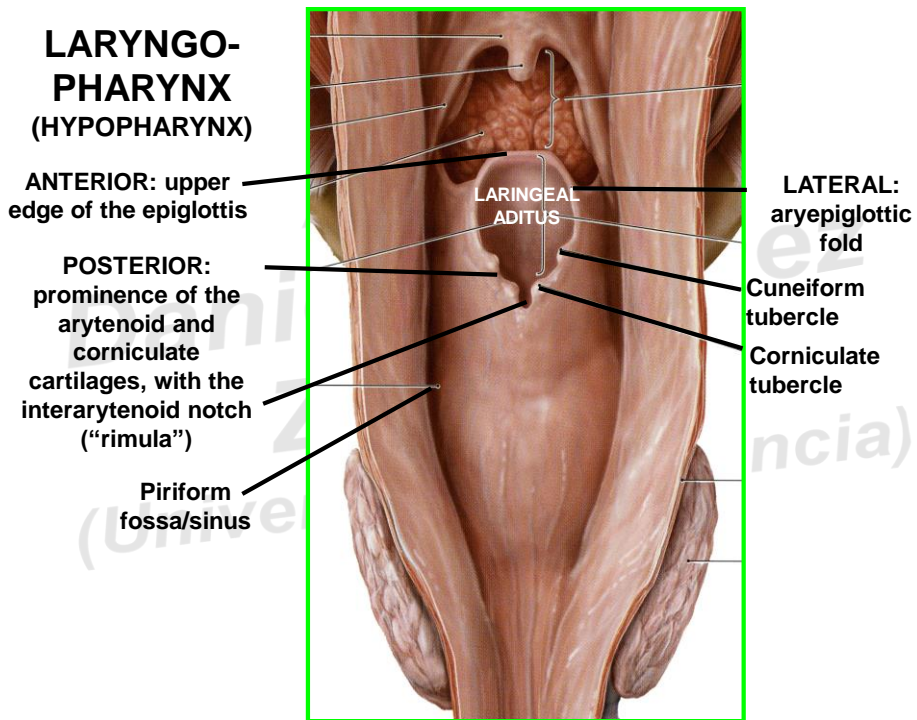
Medial and lateral gliding of the arytenoids over the cricoid.

INTRINSIC LARYNGEAL MUSCLES	Attachments		Action
CRICOTHYROID	Lateral surface of cricoid arch	OBLIQUE: thyroid, inferior horn	Anterior-inferior tilting of thyroid, STRETCHING AND TENSING the vocal ligaments.
		STRAIGHT: lower border of the thyroid lamina, in front of the oblique part	
THYROARYTENOID	Inner surface of the thyroid angle	Anterolateral surface of the arytenoid	Thyroarytenoid medially rotates arytenoids: approximation of vocal folds and CLOSING OF THE RIMA GLOTTIDIS
VOCALIS		Vocal process of the arytenoid (following the vocal ligament)	Both, SHORTENING AND RELAXING (INCREASING THE TURGIDITY) of the vocal ligaments.
TRANSVERSE ARYTENOID (it's the only one unpaired)	Muscular process of the arytenoid (posterior surface)	Muscular process of the other arytenoid	They pull both arytenoids and vocal ligaments together, CLOSING THE RIMA GLOTTIDIS.
OBLIQUE ARYTENOID		Vertex of the other arytenoid. Some fibres continue into the aryepiglottic fold (ARYEPIGLOTTIC MUSCLE).	
POSTERIOR CRICOARYTENOID		Posterior surface of cricoid lamina	
LATERAL CRICOARYTENOID	(anterior surface)	Upper border of the cricoid arch	Medial rotation of arytenoids: approximation of vocal folds and CLOSING OF THE RIMA GLOTTIDIS.

For PHONATION it is necessary:

- Turgidity in the vocal folds (thyroarytenoids, vocalis)
- Tension in the vocal folds (cricothyroids)
- Closing the rima glottidis by approximation of the vocal folds (transverse and oblique arytenoids, lateral cricoarytenoids, thyroarytenoids).

For BREATHING, the rima glottidis must open by separation of the vocal folds (posterior cricoarytenoids).



INNERVATION: laryngeal nerves (VAGUS)

Motor: "ARTICULATOR"

Viscerosensitive: "TUSSICULAR"

INNERVATION

1) SUPERIOR LARYNGEAL nerve:

- INTERNAL branch: SENSORY. Pierces the thyrohyoid membrane. Innervates the supraglottic and transglottic regions down to the vocal folds.
- EXTERNAL branch: MOTOR. It innervates the CRICOTHYROID muscle.

2) RECURRENT or INFERIOR LARYNGEAL nerve: MIXED.

It innervates ALL THE OTHER LARYNGEAL MUSCLES. It enters the larynx deep into the inferior pharyngeal constrictor muscle, close to the posterior border of the thyroid gland. Its sensory branch innervates the subglottis. A communicating branch reaches the internal branch of the superior laryngeal nerve (ANSA GALENI)

LARYNGEAL NERVES LESIONS

1) Unilateral complete palsy of the RECURRENT LARYNGEAL NERVE:

- Isolated paralysis of all the laryngeal muscles on the affected side except cricothyroid.
- The patient may be asymptomatic or have a hoarse voice. Loss of ability to manipulate pitch.

2) Lesion of the SUPERIOR LARYNGEAL NERVE AS WELL AS THE RECURRENT LARYNGEAL NERVE:

- Paralysis of all laryngeal musculature (including cricothyroid).
- The affected cord is paralysed and lies in the so-called 'cadaveric' position halfway between abduction and adduction.
- If the lesion is unilateral, the voice is weak and hoarse, but if it is bilateral, phonation is almost absent, the vocal pitch cannot be altered, and the cough is weak and ineffective.

3) Lesion of the EXTERNAL LARYNGEAL NERVE:

- Mild hoarseness, reduced pitch and loudness in bilateral lesions.
- These effects may not be noticeable when lesions are unilateral.

VASCULAR SUPPLY:

1) ARTERIES:

- **SUPERIOR LARYNGEAL ARTERY**, from the superior thyroid artery (external carotid). It pierces the thyrohyoid membrane with the superior laryngeal nerve (which is usually above the artery).

- Cricothyroid branch, also from the superior thyroid artery.

- **INFERIOR LARYNGEAL ARTERY**, from the inferior thyroid artery (thyrocervical trunk, subclavian). It is a satellite of the recurrent laryngeal nerve.

2) VEINS: parallel to the arteries.

-**SUPERIOR LARYNGEAL VEIN**: it drains into the superior thyroid vein (internal jugular).

-**INFERIOR LARYNGEAL VEIN**: it drains into the inferior thyroid vein (left brachiocephalic vein).

Superior and inferior arteries and veins show several communications between them and the contralateral vessels.

THYROID LOBES: RELATIONS

ANTERIOR/ LATERAL	Pretracheal lamina of the cervical fascia. Infrahyoid muscles.
MEDIAL	Thyroid isthmus. From bottom to top: 5 or 6 first tracheal rings (it is intensely attached to the first ring), cricoid and postero-inferior end of the thyroid cartilage.
POSTERIOR/ MEDIAL	Oesophagus and recurrent laryngeal nerve.

PARATHYROID GLANDS:

- There are two on each side, superior and inferior.
- They are usually in the postero-medial border of the thyroid lobes:
 - superior: above the entry point of the inferior thyroid artery, at a level with the cricoid cartilage.
 - inferior: below the entry point of the inferior thyroid artery, at a level with the first tracheal rings.
- **VASCULAR SUPPLY:** from the inferior thyroid artery or from anastomoses between the superior and inferior thyroid arteries.

**VISCERAL ANATOMY OF THE HEAD
AND NECK:**

PHARYNX

Muscle		Attachment	Attachment	Actions	
P A L A T I N E M U S C L E S	PALATOGLOSSUS	Palatine aponeurosis	Side of the tongue	It elevates the root of the tongue and closes the isthmus of the fauces.	
	TENSOR VELI PALATINI <i>(innervated by the mandibular nerve, V₃)</i>		Scaphoid fossa of the pterygoid process and sphenoidal spine. Eustachian tube.	It tenses the soft palate and OPENS THE TUBE.	
	LEVATOR VELI PALATINI		Inferior surface of the petrous portion of the temporal bone (in front of the carotid canal). A few fibres attach to the Eustachian tube.	It ELEVATES the posterior part of the soft palate. Little effect on the Eustachian tube.	
	MUSCULUS UVULAE		Mucosa of the uvula. The two sides of the muscle are united.	It retracts the uvula, thickening the soft palate.	
	PALATOPHARYNGEUS <i>(it is a pharyngeal muscle)</i>	E L E V A T O R S	Base of the styloid process	Pharyngeal fascia and posterior border of the thyroid cartilage.	It also closes the isthmus of the fauces.
	STYLOPHARYNGEUS <i>(it is the only muscle innervated only by the glossopharyngeal nerve)</i>				Both of them shorten and ELEVATE THE PHARYNX and the larynx.
SALPINGOPHARYNGEUS	Eustachian tube	It blends with the palatopharyngeus.	It ELEVATES THE PHARYNX and opens the tube.		
C O N S T R I C T O R	SUPERIOR	Medial pterygoid plate (PTERYGOPHARYNGEUS), pterygomandibular raphe (BUCOPHARYNGEUS), mylohyoid line of the mandible (MYLOPHARYNGEUS), side of the tongue (GLOSSOPHARYNGEUS)		The two sides of the muscle are united posteriorly, into the median pharyngeal raphe. They act as sphincters and have a PERISTALTIC effect (they propel the bolus towards the oesophagus).	
	MIDDLE	Stylohyoid ligament and the angle between both hyoid cornua.			
	INFERIOR	Oblique line of thyroid lamina (THYROPHARYNGEUS), side of the cricoid cartilage (CRICOPHARYNGEUS)			

ORAL OR LINGUAL PHASE OF DEGLUTITION (voluntary):
Elevation of the anterior part of the tongue, which forms a midline gutter to accommodate the bolus. The oropharyngeal isthmus is first closed and then opens at the end.

PHARYNGEAL PHASE OF DEGLUTITION (reflex):
Elevation of the hyoid bone and larynx (epiglottis closes the laryngeal aditus). Tension and elevation of the soft palate (which closes the communication with the nasopharynx).
Start of the peristaltic wave.

OESOPHAGEAL PHASE OF DEGLUTITION (reflex):
Propulsion of the bolus towards the oesophagus.

POST-STYLOID SPACE

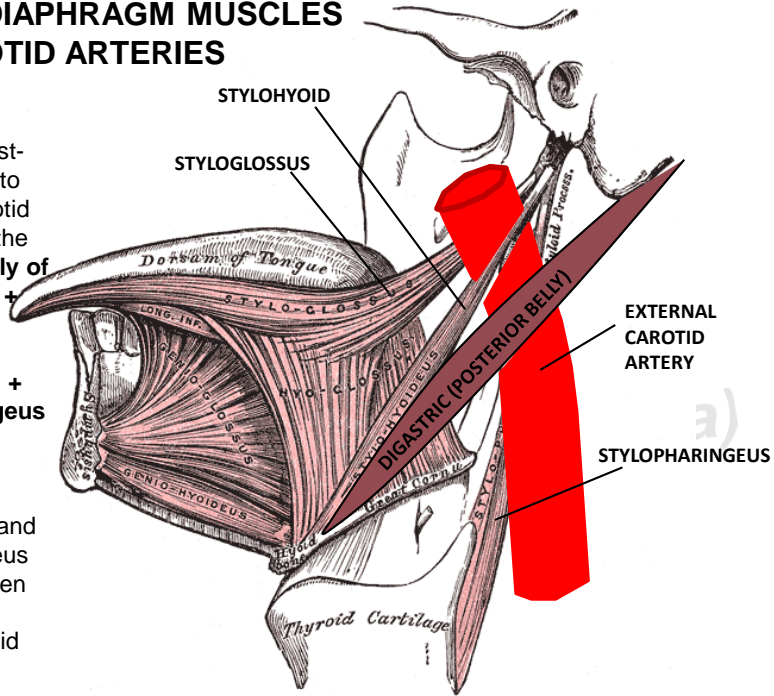
ABOVE	Cranial base, with jugular and carotid foramina.
LATERALLY	Sternocleidomastoid
MEDIAALLY	Pharynx
POSTERIORLY	Deep cervical fascia with prevertebral muscles.
BELOW	Plane following the inferior border of the mandible.
ANTERIORLY	STYLOID DIAPHRAGM, formed by Riolan's bouquet (3 muscles: stylohyoid, styloglossus and stylopharyngeus, and 2 ligaments: stylohyoid and stylomandibular) and the posterior belly of the digastric muscle, and the fascia which envelopes them all.
CONTENTS	Internal and external carotid arteries, internal jugular vein with jugular lymphatic ganglia, cranial nerves IX, X, XI and XII, superior cervical ganglion of the sympathetic trunk.

PERITONSILLAR SPACE (+ parotid cell = pre-styloid space)

BELOW	Inferior border of the mandible
ABOVE	Cranial base
LATERALLY	Medial pterygoid muscle. Posterior to it, the PAROTID CELL.
MEDIAALLY	Pharynx, with the palatine tonsil.
POSTERIORLY	Styloid diaphragm

STYLOID DIAPHRAGM MUSCLES AND CAROTID ARTERIES

- The external carotid artery leaves the post-styloid space to enter the parotid cell between the **posterior belly of the digastric + stylohyoid** laterally and **styloglossus + stylopharyngeus** medially.
- Styloglossus and stylopharyngeus remain between internal and external carotid arteries.



VISCERAL ANATOMY OF THE THORAX

MEDIASTINUM: GENERAL ORGANIZATION. THYMUS.

BOUNDARIES, SUBDIVISIONS AND CONTENTS OF THE MEDIASTINUM

SUPERIOR	Thoracic inlet (T1, first ribs, sternal manubrium)
INFERIOR	Diaphragm
LATERAL	Parietal pleura of both sides (MEDIASTINAL pleura)
POSTERIOR	Thoracic spine
ANTERIOR	Sternum

I N F E R I O R	SUPERIOR (between thoracic inlet and a plane from the lower surface of T4 to the manubriosternal joint)	Lower ends of anterior neck muscles Aortic arch and its branches Superior half of the superior vena cava and its branches Vagus, phrenic and left recurrent laryngeal nerves Trachea, oesophagus and thoracic duct Most of the thymus
	ANTERIOR (between the sternal body and pericardium)	Sternopericardial ligaments Part of the thymus
	MIDDLE (between the anterior surface of the pericardium and the tracheal bifurcation/ posterior surface of the pericardium)	Heart, pericardium and ascending aorta Lower half of the superior vena cava Tracheal bifurcation and main bronchi Pulmonary vessels Phrenic nerve
	POSTERIOR (between the tracheal bifurcation/ posterior surface of the pericardium and the thoracic spine)	Descending thoracic aorta Azygos and hemiazygos veins Splanchnic and vagus nerves Thoracic duct Oesophagus

BLOOD-THYMUS BARRIER:
 cortical lymphocytes are separated from blood circulation by means of sheaths of thymic epithelial cells surrounding the cortical vessels.

Author:
Daniel Sánchez
Zuriada
(Universitat de València)

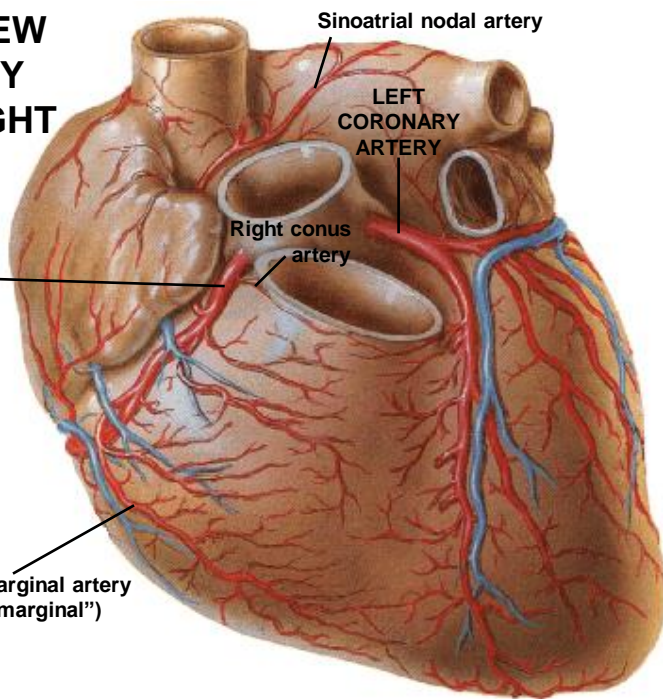
VISCERAL ANATOMY OF THE THORAX

CORONARY VESSELS

ANTERIOR VIEW OF CORONARY VESSELS: RIGHT CORONARY ARTERY

- Conus arteries supply the first portion of the pulmonary trunk (the conus arteriosus).
- Sinoatrial nodal artery supplies the sinoatrial node and part of both atria, mostly the right one.

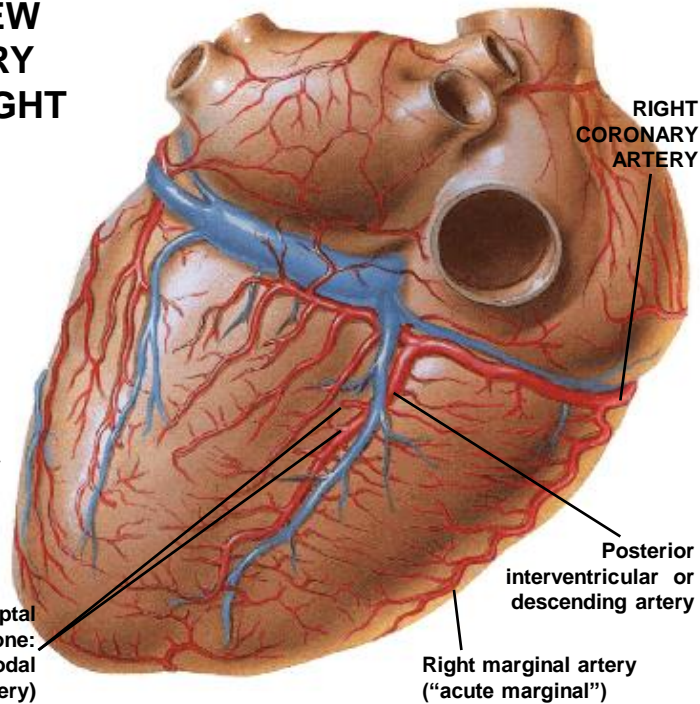
Right marginal artery
("acute marginal")



INFERIOR VIEW OF CORONARY VESSELS: RIGHT CORONARY ARTERY

- Posterior septal branches supply the posterior third of the interventricular septum.
- The first posterior septal branch usually supplies the atrioventricular node.

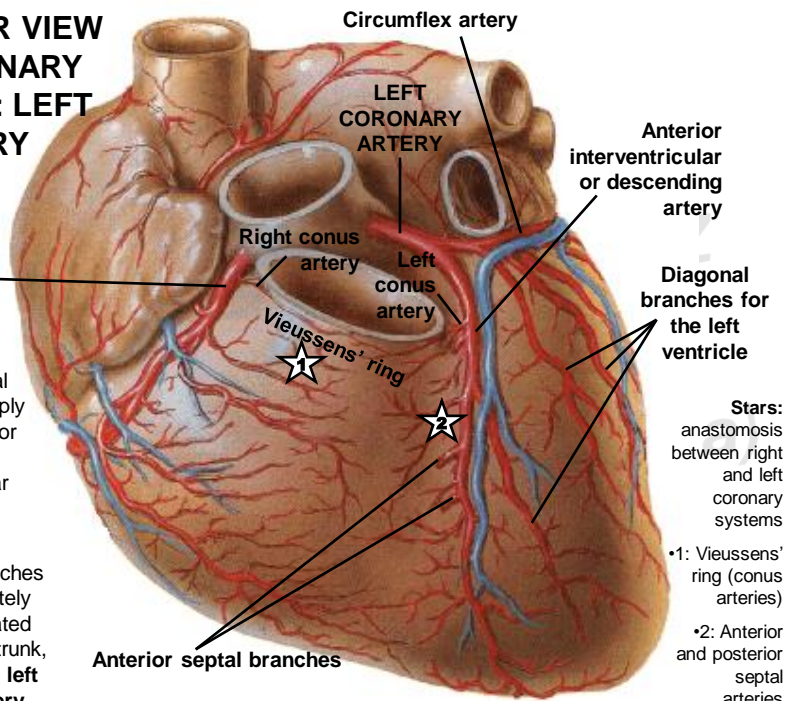
Posterior septal branches (the first one: atrioventricular nodal artery)



ANTERIOR VIEW OF CORONARY VESSELS: LEFT CORONARY ARTERY

- Anterior septal branches supply the two anterior thirds of the interventricular septum.
- If one of the diagonal branches arises separately from a trifurcated left coronary trunk, it is called the left diagonal artery.

RIGHT CORONARY ARTERY

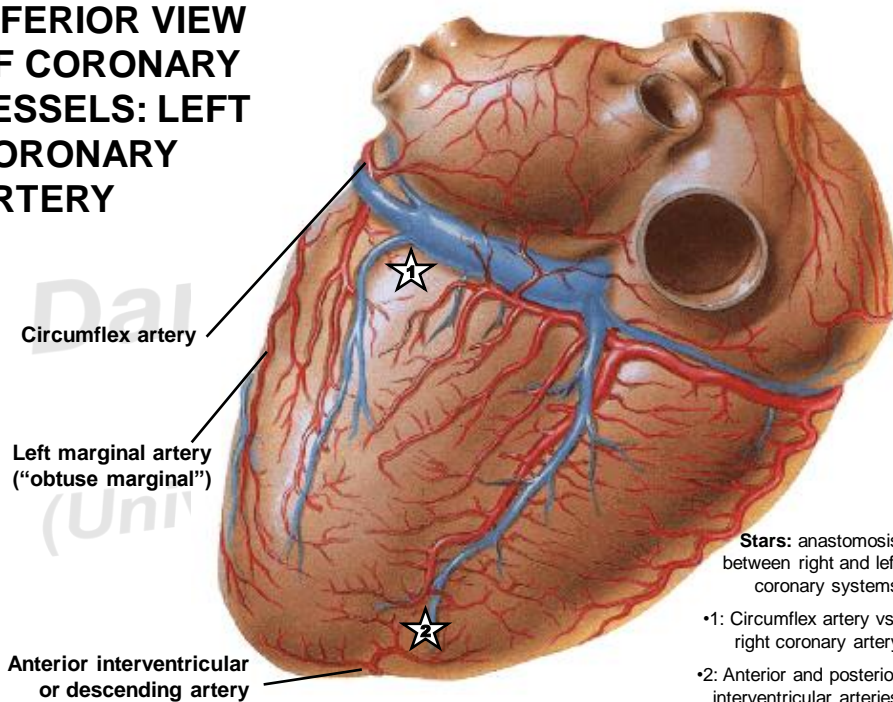


Stars: anastomosis between right and left coronary systems

•1: Vieussens' ring (conus arteries)

•2: Anterior and posterior septal arteries

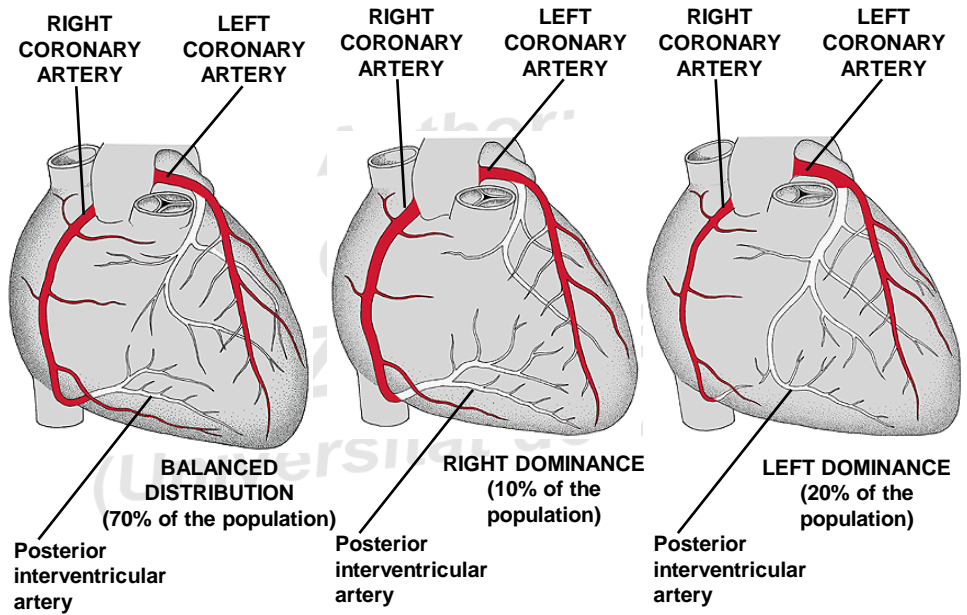
INFERIOR VIEW OF CORONARY VESSELS: LEFT CORONARY ARTERY



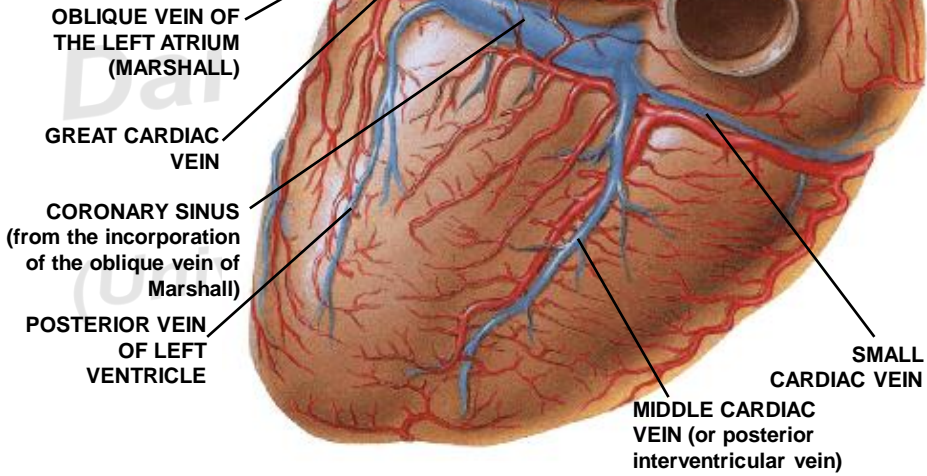
Stars: anastomosis between right and left coronary systems

- 1: Circumflex artery vs. right coronary artery
- 2: Anterior and posterior interventricular arteries

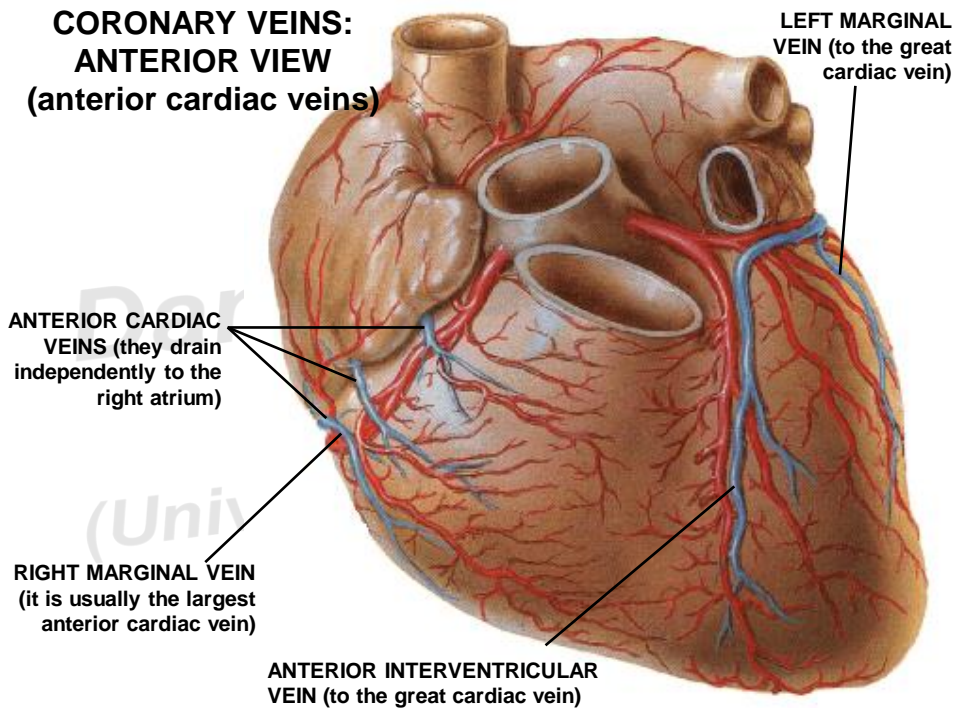
ANATOMICAL VARIATIONS: DOMINANCE



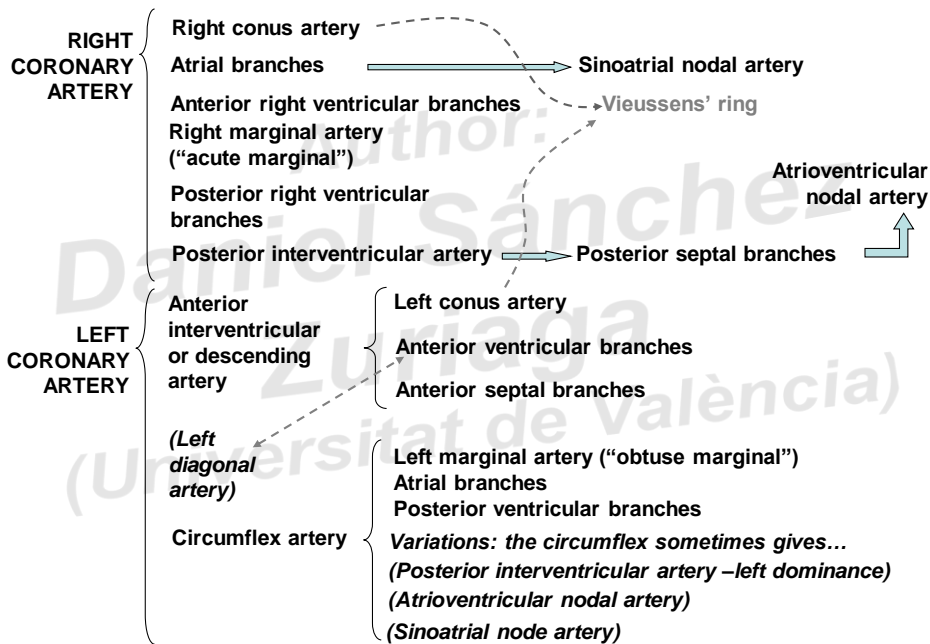
**CORONARY VEINS:
POSTERO-INFERIOR
VIEW (coronary sinus
and its afferents)**



**CORONARY VEINS:
ANTERIOR VIEW
(anterior cardiac veins)**



CORONARY ARTERIES



CORONARY ARTERIES TERRITORIES

RIGHT CORONARY ARTERY

- Most of the right ventricle.
- Posterior third of the interventricular septum.
- Part of the diaphragmatic surface of the left ventricle.
- Right and part of left atria.
- Conduction system before the bundle of His.

LEFT CORONARY ARTERY (it usually provides a greater volume of tissue)

- Most of the left ventricle.
- A band of the right ventricle just close to the anterior interventricular groove.
- Two anterior thirds of the interventricular septum.
- Most of the left atrium.

VEINS

- CORONARY SINUS and its afferents: most of the heart, with the septa.
- ANTERIOR CARDIAC VEINS: anterior surface of the right ventricle.
- SMALL or THEBESIAN CARDIAC VEINS: they open directly to whichever cavity they are draining. They cover variable extensions of tissue in both atria (mostly the right atrium) and right ventricle.

Author:
VISERAL ANATOMY OF THE THORAX

HEART: CONDUCTING SYSTEM AND INNERVATION

CARDIAC PLEXUS

•Sympathetic nervous system
INCREASES HEART RATE and
DILATES the coronary arteries.

•Parasympathetic nervous system
DECREASES HEART RATE and
CONTRACTS coronary arteries.

CARDIAC PLEXUS

SUPERFICIAL OR VENTRAL PART OF THE CARDIAC PLEXUS: it is formed by the cardiac branch of the left superior cervical sympathetic ganglion and the lowest of the two cervical cardiac branches of the left vagus nerve.

DEEP OR DORSAL PART OF THE CARDIAC PLEXUS: it is formed by the cardiac branches of the cervical and upper thoracic sympathetic ganglia, and of the vagus and recurrent laryngeal nerves, all from both sides. The only cardiac nerves which do not join it are those which join the superficial part of the plexus.

CARDIAC PLEXUS

- The second neuron of the cardiac sympathetic pathway is in the cervical and upper thoracic ganglia of the sympathetic trunk.
- The second neuron of the cardiac parasympathetic pathway is in:
 - ✓ ganglia from the CARDIAC and adjacent plexuses.
 - ✓ INTRINSIC neurons in the subepicardial connective tissue of the atria and interatrial septum. They are most numerous near the sinoatrial and atrioventricular nodes.

VISCERAL ANATOMY OF THE THORAX

Author:

THORACIC AORTA. POSTERIOR MEDIASTINUM: OESOPHAGUS. AZYGOS VEINS. THORACIC DUCT. SPLANCHNIC NERVES.

<p>ASCENDING AORTA: from the base of the left ventricle to the superior border of the second left costal cartilage. It is dilated by the coronary sinuses (aortic BULB).</p>	<ul style="list-style-type: none"> • ANTERIOR: <u>pericardium</u>, fatty tissue, thymus • POSTERIOR: right pulmonary artery and principal bronchi • RIGHT: superior vena cava • LEFT: pulmonary trunk <p style="text-align: center;">BRANCHES: coronary arteries</p>
<p>AORTIC ARCH: from the end of the aortic bulb to the left of T4 vertebral body. It curves back and to the left.</p>	<ul style="list-style-type: none"> • ANTERIOR / LEFT: left mediastinal pleura, left phrenic nerve, autonomic branches for the cardiac plexus, left vagus nerve with the origin of its recurrent laryngeal branch. • POSTERIOR / RIGHT: sequentially from anterior to posterior, with trachea, left recurrent laryngeal nerve, oesophagus, thoracic duct and spine. • SUPERIOR: its BRANCHES arise from the convex aspect of the arch: sequentially, right to left, the brachiocephalic trunk, left common carotid and left subclavian arteries. • INFERIOR: bifurcation of the pulmonary trunk, ligamentum arteriosum, left main bronchus and left recurrent laryngeal nerve.
<p>(DESCENDING) THORACIC AORTA: from the lower border of the fourth thoracic vertebra (to the left of the spine) to the lower border of the 12th thoracic vertebra in the diaphragmatic aortic aperture (anterior to the spine).</p>	<ul style="list-style-type: none"> • ANTERIOR: top to bottom, the left pulmonary pedicle, the pericardium covering the left atrium, oesophagus and diaphragm. • POSTERIOR: spine and hemiazygos veins. • RIGHT: oesophagus (above), right lung and pleura, azygos and thoracic duct. • LEFT: left pleura and lung. <p style="text-align: center;">BRANCHES. VISCERAL: pericardial, bronchial, oesophageal, and mediastinal arteries. PARIETAL: diaphragmatic and posterior intercostal arteries.</p>

RELATIONS OF THE OESOPHAGUS AT THE CERVICAL LEVEL

Anterior: cricoid/ trachea

Posterior: spine and prevertebral muscles

Lateral: Thyroid and parathyroid glands,
recurrent laryngeal nerve

THORACIC RELATIONS OF THE OESOPHAGUS

Anterior: trachea, left brachiocephalic vein, aortic arch, left main bronchus

Posterior: spine, thoracic duct, posterior intercostal vessels, aorta near the diaphragm

Lateral: recurrent laryngeal nerves, pleural cavities, aorta (to the left)

INNERVATION: OESOPHAGEAL PLEXUS

INNERVATION:
oesophageal plexus
(thoracic portion) and
recurrent laryngeal
nerves (cervical
portion)

AZYGOS VEIN

- Origin: medial trunk, not constant (lumbar azygos, from the inferior vena cava) + lateral trunk (union of ascending lumbar and subcostal veins)
- It lies on the right side, anterior to the T12 to T5 vertebral bodies.
- To the left, it has the thoracic duct and aorta, and to the right, the right greater splanchnic nerve and the right lung with its pleura.
- It ascends at the level of T4, where it arches forward, above the right pulmonary hilum (AZYGOS ARCH) and reaches the superior vena cava.
- AFFERENTS: right posterior intercostal veins (the first three via the right superior intercostal vein). Also oesophageal, pericardial, mediastinal and right bronchial veins.

AZYGOS AND HEMIAZYGOS VEINS

ACCESSORY HEMIAZYGOS VEIN

- At the level of T7, it crosses the vertebral column to drain to the azygos vein. It can also drain to the hemiazygos.
- AFFERENTS: left bronchial and 3 to 7 left posterior intercostal veins.

HEMIAZYGOS VEIN

- Origin: medial trunk, not constant (renoazygolumbar arch) + lateral trunk (union of ascending lumbar and subcostal veins)
- It lies on the left, at the level of T8. Then it crosses the vertebral column posterior to the aorta, oesophagus and thoracic duct, to drain to the azygos vein.
- AFFERENTS: left posterior intercostal veins 8 to 11.

•From the upper border of the cisterna chyli (Pecquet's cistern), at the inferior border of T12.

•It enters the thorax through the aortic hiatus of the diaphragm.

•It lies between the vertebral column (posterior), oesophagus (anterior), azygos vein (right) and aorta (left).

THORACIC DUCT

•At the level of C7, it curves and reaches the junction of the left subclavian and internal jugular veins.

• It drains the lymph of the whole body, excepting the right side of the head, neck and thoracic walls, right upper limb, right lung and right side of the heart (right lymphatic duct).

THORACIC SPLANCHNIC NERVES

GREATER splanchnic nerve

- From fifth to ninth thoracic ganglia.
- It crosses the homolateral diaphragmatic crus.
 - It ends mainly in the coeliac ganglion, but partly in the aorticorenal ganglion and suprarenal medulla.

LESSER splanchnic nerve

- From tenth to twelfth thoracic ganglia.
- It crosses the diaphragm with the greater splanchnic.
 - It ends in the aorticorenal ganglion.

LOWEST (LEAST) splanchnic nerve

- From the twelfth thoracic ganglion, when its fibres leave independently.
 - It ends in the aorticorenal ganglion.

Author:
Daniel Sánchez
Zurita
(Universitat de València)

VISCERAL ANATOMY OF THE THORAX

TRACHEA. MAIN BRONCHI. LUNGS

DEVELOPMENT OF THE LUNG BUD

The foregut –digestive tract– has anteriorly the somatic cavity, which at this level contains the heart and is then called the **pericardial cavity**. This cavity's wall is covered by a membrane which is going to become the pleurae and the pericardium.

The lung buds come from the foregut, and protrude progressively inside the somatic cavity. They drag with them the membrane which covers the cavity's wall, which becomes the **visceral pleura** (the membrane which remains covering the wall is the **parietal pleura**). At the same time, the pleuropericardial folds (dragging inside them the phrenic nerves) separate the portion of the cavity where the lung buds are from the portion of the cavity occupied by the heart.

The fusion of both pleuropericardial folds separates two **pleural cavities** (one for each lung: the cavity's walls are covered by the **parietal pleura**, the lung is covered by the **visceral pleura** and **both pleurae are continuous with each other** at the level of the pulmonary hilum) and a pericardial cavity. The phrenic nerve gets "immured" between pleura and pericardium.

CERVICAL RELATIONS OF THE TRACHEA

Vascular supply:
inferior thyroid

- ANTERIOR: infrahyoid muscles. 2nd to 4th rings, thyroid isthmus. Below: thyroid vessels, thymic remains.
- POSTERIOR: oesophagus. Recurrent laryngeal nerves lie in the groove between the trachea and the oesophagus.
- LATERAL: lobes of the thyroid gland, common carotid arteries.

ANTERIOR:

- Sternal manubrium
- Left brachiocephalic trunk
- First portion of the aortic arch

RIGHT:

- Right lung
- Arterial brachiocephalic trunk and right brachiocephalic vein
- Azygos and superior vena cava

THORACIC
RELATIONS OF
THE TRACHEA
Vascular supply:
bronchial vessels

LEFT:

- Left lung
- Last portion of the aortic arch
- Left common carotid and subclavian arteries

POSTERIOR: oesophagus

MAIN BRONCHI

RIGHT MAIN BRONCHUS

- Wider, shorter and more vertical (FOREIGN BODIES)
- It is divided into three lobar bronchi:
 - right superior lobar bronchus or eparterial bronchus, above the pulmonary artery, before the hilum
 - middle lobar bronchus
 - right inferior lobar bronchus
- The azygos arch arches over it.

LEFT MAIN BRONCHUS

- It's horizontal: crosses in front of the oesophagus and the descending thoracic aorta.
- It is divided into two lobar bronchi, after the hilum:
 - left superior lobar bronchus
 - left inferior lobar bronchus
- The aortic arch arches over it.

TRACHEAL and BRONCHIAL INNERVATION (from the pulmonary plexuses):

- SYMPATHETIC: bronchodilator and reduces mucous secretion.
- PARASYMPATHETIC: bronchoconstrictor and increases mucous secretion.

PULMONARY VESSELS

RIGHT SUPERIOR PULMONARY VEIN

- It drains the oxygenated blood from the right superior and middle lobes.

LEFT SUPERIOR PULMONARY VEIN

- It drains the oxygenated blood from the left superior lobe.

MIDDLE LOBAR VEIN

RIGHT INFERIOR PULMONARY VEIN

- It drains the oxygenated blood from the right inferior lobe.

LEFT INFERIOR PULMONARY VEIN

- It drains the oxygenated blood from the left inferior lobe.

RIGHT PULMONARY ARTERY

LEFT PULMONARY ARTERY

INTRAPULMONARY CIRCULATION

Branches of the
PULMONARY ARTERY
(venous blood): they
follow the bronchi
inside the segment.

Branches of the
PULMONARY VEINS
(arterial blood): they
follow the separations
between segments.
They only meet the
bronchial and arterial
branches at the hilum.

BRONCHIAL VESSELS:

- This system irrigates the pulmonary parenchyma.
- They are usually two arteries to the left -branches of the descending thoracic aorta—and one to the right –branch of either the descending thoracic aorta or the 3rd posterior intercostal artery or the left superior bronchial.
- Veins separate into two systems: DEEP, draining to the pulmonary veins or the left atrium, and SUPERFICIAL, draining to the azygos vein to the right and the accessory hemiazygos to the left. This means a little venous and arterial blood get mixed at this level.
- The main trunks of those veins and arteries are on the dorsal surface of the main bronchi.

PULMONARY INNERVATION: PULMONARY PLEXUSES

The **anterior and posterior pulmonary plexuses**, separated by the tracheal bifurcation and connected to the cardiac plexuses, innervate the trachea and the bronchi. The trachea is innervated by branches of the vagi, recurrent laryngeal nerves and sympathetic trunks (sympathetic preganglionic axons synapse on the paravertebral ganglia, from the last cervical ones to the first thoracic ones, similarly to the cardiac innervation). The nerves enter the lung as networks that travel along branches of the bronchi and pulmonary and bronchial vessels. Vagal preganglionic axons synapse on small ganglia within the walls of the tracheobronchial tree. The parasympathetic nervous system is the dominant neuronal pathway in the control of airway smooth muscle tone. Stimulation of parasympathetic nerves causes bronchoconstriction, mucus secretion and bronchial vasodilation.

PLEURAE

Here you can see a picture of a recently opened thoracic cavity, with both pleural sacs preserved in place and separated from the ribs. What you see is the parietal pleura, and how both pleural sacs (parietal pleurae) contact in the midline (although each pleural cavity is completely separated from the other).



Depending on the structure which is covering, parietal pleura is subdivided into several partitions. **Cervical pleura** covers the highest part of the pleural cavity, where the pulmonary apex is. It reaches higher than the first rib, inside the cervical region.

CERVICAL PLEURA or PLEURAL CUPULA

MEDIASTINAL PLEURA

VERTEBRO-COSTAL PLEURA

DIAPHRAGMATIC PLEURA

PLEURAL SINUSES OR RECESSES

They are extreme portions of the pleural cavity which not even at maximal inspiration get to be occupied by the lung. So they do not contain visceral pleura, and in them two partitions of the parietal pleura get in contact (and name each sinus). The most important one is the **costo-diaphragmatic sinus**.

So the pleurae reach further than the lungs. It is important to know at which thoracic and vertebral levels we can find pulmonary tissue and where we can find a pleural sinus in order to place correctly the stethoscope for pulmonary auscultation or use a needle to drain liquid that may accumulate into the costo-diaphragmatic sinus. You have to learn the anterior, posterior and lateral limits of the pulmonary tissue, pulmonary lobes and pleural sinuses.

Of course, the costo-diaphragmatic sinuses will follow the diaphragm, and through it be in contact with the most superior abdominal viscera (their abdominal relations are important!). For example, the right costo-diaphragmatic sinus is formed by the costal parietal pleura and the diaphragmatic parietal pleura, when they contact each other without pulmonary tissue in between. And this space is closely related to the ribs, the diaphragm, and through it to the abdomen (which in this case contains mostly the liver).

PULMONARY APEX AND PLEURAL CUPULA

As we said before, **cervical pleura** covers the highest part of the pleural cavity, where the pulmonary apex is. It reaches higher than the first rib, inside the cervical region. It is closely related to carotid and subclavian arteries, and to the union of both brachiocephalic trunks to form the superior vena cava at the right side.

There are several ligaments keeping the pleural cupula in place (cervical pleura is suspended from them, so they are called the **suspensory ligaments** of the pleura). They are: the **costopleural ligament**, the **vertebropleural ligament** and the **vertebrocostopleural ligament**. The vertebrocostopleural ligament goes from the spinous process of C7 to the first rib and the portion of cervical pleura closest to it. This ligament may contain muscle fibres, and is then called **scalenus minimus muscle**.

The **cervicothoracic or stellate ganglion (C7)**, which comes from the fusion of the last cervical and the first thoracic ganglia of the sympathetic trunk, is closely related to the pleural cupula.

LINES OF PLEURAL REFLECTION: PULMONARY LIGAMENT

Parietal pleura reflects (changes direction to start covering the lung, and then become visceral pleura) at the level of the pulmonary hilum. This **line of pleural reflection** continues inferiorly to become the **pulmonary ligament**, which ends with a free border just before reaching the diaphragm.

PLEURAL INNERVATION AND VASCULAR SUPPLY

VASCULAR SUPPLY

• VISCERAL PLEURA:

Bronchial vessels

• PARIETAL PLEURA:

Parietal vessels: intercostal arteries, medial thoracic, pericardiophrenic artery.

CERVICAL pleura is supplied by branches of the subclavian.

MEDIASTINAL pleura is supplied by mediastinal branches of the descending thoracic aorta.

INNERVATION:

•VISCERAL PLEURA: visceral afferents that reach it by travelling along the bronchial vessels with autonomic fibres.

• PARIETAL PLEURA:

COSTAL and PERIPHERAL DIAPHRAGMATIC parietal pleurae: intercostal nerves

MEDIASTINAL and CENTRAL DIAPHRAGMATIC parietal pleurae: phrenic nerve (C3 a C5)

THERE ARE DIFFERENT PATTERNS OF REFERRED PAIN!

Irritation of the peripheral diaphragmatic pleura results in pain that is referred along the intercostal nerves to the appropriate part of the thoracic or abdominal wall, whereas irritation of the central diaphragmatic pleura causes pain that is referred to the lower neck and shoulder tip, i.e. to the C3, 4 dermatomes (the levels of origin of the phrenic nerve).

VISCERAL ANATOMY OF THE
ABDOMEN

BILIARY TREE

RELATIONS OF THE EXTRAHEPATIC BILIARY
TREE: CALOT'S TRIANGLE

CALOT'S TRIANGLE

- MEDIAL:** common hepatic duct
- LATERAL:** cystic duct
- SUPERIOR:** inferior surface of the liver
(segment V)
- CONTENTS:** **cystic artery** and possible
aberrant branches of the hepatic artery and
accessory bile ducts.

SURFACE PROJECTION OF THE BILIARY TREE

The fundus of the gallbladder often lies in contact with the anterior abdominal wall behind the **ninth costal cartilage**, where the lateral edge of the right rectus abdominis crosses the costal margin (**cystic point**).

VISCERAL ANATOMY OF THE ABDOMEN

**DUODENUM.
PANCREAS.**

RELATIONS OF THE DUODENUM: FIRST PORTION (SUPERIOR)	SUPERIOR	Quadrate lobe of the liver and gallbladder. The entrance of the bursa omentalis (omental foramen or foramen of Winslow).
	POSTERIOR	Inferior vena cava. Gastroduodenal artery, common bile duct and portal vein.
	INFERIOR	Head and neck of pancreas.
	MEDIAL	Pylorus.
SECOND PORTION (DESCENDING)	ANTERIOR	From top to bottom: right hepatic lobe (duodenal surface), transverse colon and root of the mesocolon, jejunum.
	POSTERIOR	Right kidney
	LATERAL	Right colic angle
	MEDIAL	Head of the pancreas and common bile duct (it drains here).
THIRD PORTION (HORIZONTAL)	ANTERIOR	Covered by transverse colon with mesocolon. It is obliquely crossed by the root of the mesenterium, and between both mesenteric layers by the superior mesenteric vessels.
	POSTERIOR	Right to left: right gonadal vessels, inferior vena cava and abdominal aorta.
	SUPERIOR	Head of pancreas
FOURTH PORTION (ASCENDING)	ANTERIOR	Transverse colon and mesocolon
	POSTERIOR	Left renal and gonadal vessels, inferior mesenteric vein.
	MEDIAL	Uncinate process of pancreas. Upper part of the root of the mesentery. Abdominal aorta.
	LATERAL	Left kidney and ureter

VISCERAL ANATOMY OF THE ABDOMEN

KIDNEYS. URETER. ADRENAL GLANDS

KIDNEY AND PERIRENAL FASCIA

The **perirenal fascia** is a dense, elastic connective tissue sheath which envelops each kidney and suprarenal gland together with a layer of surrounding perirenal fat. The kidney and its vessels are embedded in perirenal fat, which extends into the renal sinus at the hilum.

The perirenal fascia is traditionally described as being made up of two separate entities, the **posterior/retrorenal fascia of Zuckerkandl** and the **anterior/prerenal fascia of Gerota**, which fuse laterally to form the **lateral conal fascia**. This conal fascia continues anterolaterally to blend with the transversalis fascia.

A simple nephrectomy for benign disease removes the kidney from within perirenal fascia; a radical nephrectomy (for cancer) removes the entire contents of the perirenal space including the perirenal fascia, in order to give adequate clearance around the tumour.

Above the suprarenal glands, the anterior and posterior perirenal fasciae are traditionally said to fuse with each other and to the diaphragmatic fascia. The posterior fascial layer blends bilaterally with the fascia of psoas major and quadratus lumborum. The anterior fascial layer is continuous medially with the connective tissue covering the abdominal aorta and the inferior vena cava. Sometimes it crosses the midline and it is continuous with the contralateral one.

RENAL INTERNAL MACROSTRUCTURE

The kidney has a thin fibrous **capsule**.

Deep into that, renal tissue can be divided into an internal **medulla** and external **cortex**.

- The **RENAL MEDULLA** consists of pale, striated, conical **renal pyramids (Malpighi pyramids)**, their bases peripheral, their apices converging to the renal sinus. At the renal sinus they project into calyces as **papillae**.
- The **RENAL CORTEX** is subcapsular, arching over the bases of the pyramids and extending between them towards the renal sinus as **renal columns (Bertin columns)**.

RENAL VESSELS

The **renal arteries** branch laterally from the aorta just below the origin of the superior mesenteric artery. The right renal artery is longer and a bit inferior, passing posterior to the inferior vena cava and the right renal vein. The left renal artery passes behind the left renal vein and the body of the pancreas.

The **renal veins** lie anterior to the renal arteries and open into the inferior vena cava almost at right angles. The left is much longer than the right and for this reason, the left kidney is the preferred side for live donor nephrectomy. The left renal vein runs from its origin in the renal hilum, posterior to the splenic vein and the body of pancreas, and then across the anterior aspect of the aorta, just below the origin of the superior mesenteric artery.

•The **left gonadal vein** enters the left renal vein from below and the **left suprarenal vein**, usually receiving one of the **left inferior phrenic veins**, which enters it from above.

•In its extrarenal course, each renal artery gives off one or more **inferior suprarenal arteries**, a **branch to the ureter** and branches which supply perinephric tissue, the renal capsule, and the renal pelvis.

ANTERIOR AND POSTERIOR DIVISIONS OF THE RENAL ARTERIES, WITH SEGMENTARY ARTERIES

Near the renal hilum, each artery is divided into an anterior and a posterior division, and these are divided into segmental arteries supplying the **renal vascular segments**.

Five renal arterial segments have been identified. The **apical** (Gray) or **superior** (Prometheus) segment occupies the anteromedial region of the superior pole. The **superior** (Gray) or **anterosuperior** (Prometheus) segment includes the rest of the superior pole and the central anterosuperior region. The **inferior** segment encompasses the whole lower pole. The **middle** (Gray) or **anteroinferior** (Prometheus) segment lies between the superior and inferior segments. The **posterior** segment includes the whole posterior region between the apical and inferior segments.

Vascular segments are supplied by virtual end (terminal) arteries: there are no anastomosis between the arteries of each segment. In contrast, intrarenal veins have no segmental organization and anastomose freely.

RENAL VESSELS

The segmental arteries are subdivided into two or three **interlobar** arteries, extending towards the cortex around each pyramid. At the junction of the cortex and medulla, interlobar arteries dichotomize into **arcuate arteries** which diverge at right angles. As they arch between cortex and medulla, each splits further, ultimately supplying **interlobular** arteries, which diverge radially into the cortex. The terminations of adjacent arcuate arteries do not anastomose but end in the cortex as additional interlobular arteries (remember that the circulation of each segment is terminal). Though most interlobular arteries come from arcuate branches, some arise directly from interlobar arteries. **Afferent glomerular arterioles** are mainly the lateral rami of interlobular arteries. A few arise from arcuate and interlobar arteries.

OJO CON LA TRADUCCIÓN AL CASTELLANO: *interlobar=interlobular; interlobular=interlobulillar*

NEPHRONS

The **NEPHRON** consists of a **renal corpuscle**, concerned with filtration from the plasma, and a **renal tubule**, concerned with selective resorption from the filtrate to form the urine. **Collecting ducts** carry fluid from several renal tubules to a terminal **papillary duct**, opening into a **minor calyx** at the apex of a renal papilla. Papillary surfaces show numerous minute orifices of these ducts.

The minor calyces unite with their neighbours to form two or three larger chambers, the **major calyces**.

RENAL CORPUSCLES are small rounded structures in the renal cortex. Each has a central **glomerulus** of vessels and a **glomerular (Bowman's) capsule**, from which the renal tubule originates.

•A **GLOMERULUS** is a collection of convoluted capillary blood vessels, united by a delicate **mesangial** matrix and supplied by an **afferent arteriole** which enters the capsule opposite the urinary pole, where the filtrate enters the tubule. An **efferent arteriole** emerges from the same point, the vascular pole of the corpuscle. The term glomerulus is used most frequently to describe the entire renal corpuscle, this is to say, glomerulus proper+Bowman's capsule.

•**BOWMAN'S CAPSULE** is the blind expanded end of a renal tubule, and is deeply invaginated by the glomerulus. It is lined by a simple squamous epithelium on its outer (parietal) wall; its glomerular (medial) wall is composed of specialized epithelial podocytes. Between the two walls of the capsule there is a flattened urinary, capsular or Bowman's space, continuous with the proximal convoluted tubule.

A **RENAL TUBULE** consists of a **glomerular capsule** that leads into a **proximal convoluted tubule**. This straightens as it approaches the medulla, and becomes the **descending thick limb of the loop of Henle** and then the **ascending limb** by an abrupt U-turn. The limbs of the loop of Henle are narrower and thin-walled within the deeper medullary tissue where they become the **descending and ascending thin segments**. The ascending thick limb continues into the **distal tubule**. The nephron finally straightens once more as the **connecting tubule**, which ends by joining a **collecting duct**.

Collecting ducts originate in the cortical medullary rays and join others at intervals. They finally open into wider papillary ducts which open on to a papilla, their numerous orifices forming a perforated **area cribrosa** on the surface at its tip.

The type of epithelial cell lining the different segments of the renal tubule varies according to the functional roles of the different regions, e.g. active transport and passive diffusion of various ions and water into and out of the tubules; reabsorption of organic components such as glucose and amino acids; or uptake of any proteins which leak through the glomerular filter.

The distal tubule wall shows a focal thickening, the **macula densa**, where it comes close to the vascular pole of its parent glomerulus at the start of the convoluted part of the distal tubule.

The macula densa is a sensory structure which is concerned with the regulation of blood flow and thus filtration rate (more filtration/less water resorption=more urine + less blood volume; less filtration/more water resorption=less urine + more blood volume).

RENAL TUBULE AND VESSELS

- **Efferent glomerular arterioles** from most glomeruli (except at juxtamedullary levels, this is to say, the deepest parts of the cortex, close to the medulla) split to form a dense **cortical peritubular capillary plexus** around the proximal and distal convoluted tubules.

- The vascular supply of the renal **medulla** is largely from efferent arterioles of **juxtamedullary** glomeruli. Efferent glomerular arterioles passing into the medulla split into several **descending vasa recta**. These run straight to varying depths in the renal medulla, contributing side branches to a radially elongated capillary plexus applied to the descending and ascending limbs of renal loops and to collecting ducts. The venous ends of capillaries converge to the **ascending vasa recta**, which drain into arcuate or interlobular veins. An essential feature of the vasa recta is that **both ascending and descending vessels are grouped into vascular bundles close to the limbs of renal loops and collecting ducts**. This proximity of descending and ascending vessels with each other and adjacent ducts provides the structural basis for several mechanisms of ionic exchange such as the **countercurrent multiplier mechanism**, which allow the control of the ionic filtrate and resorption (and which you will study in detail in other subjects during your degree).

RENAL PELVIS

Confluence of the major calyces.

It can be AMPULLAR or RAMIFIED (more frequent). It is continuous with two or three major calyces:

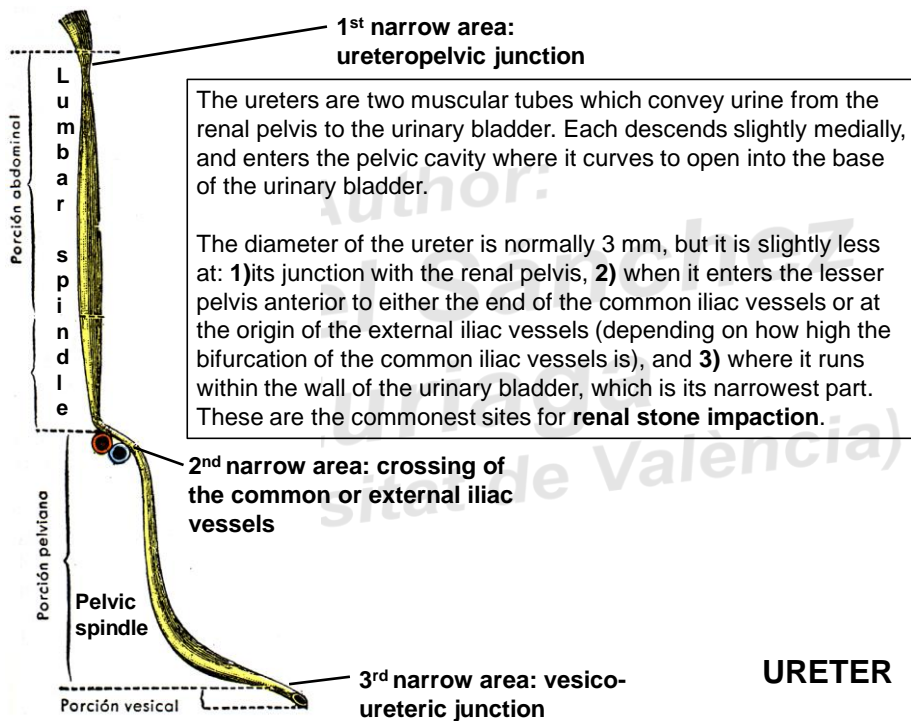
SUPERIOR

MIDDLE

INFERIOR

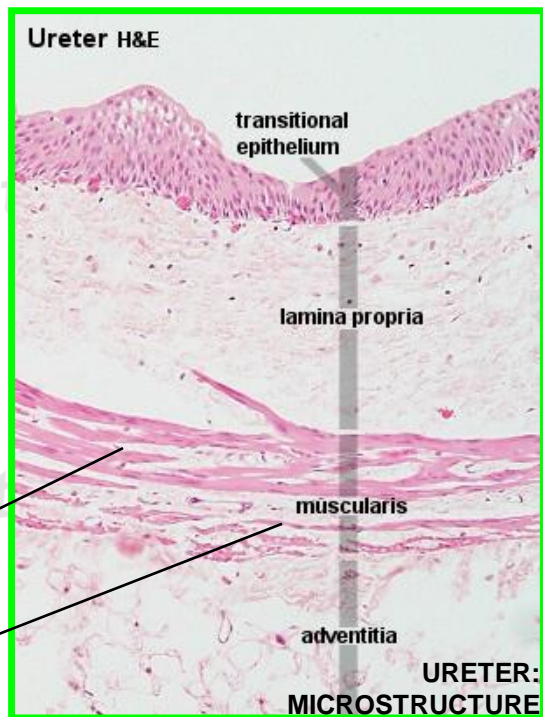
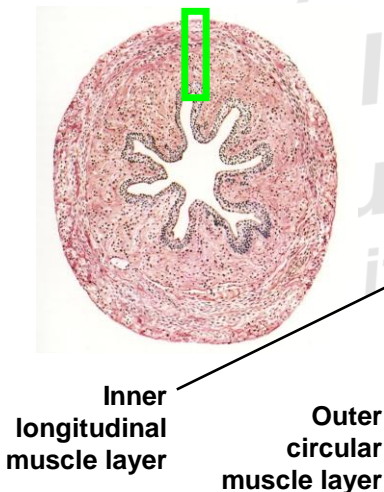
It is the most posterior structure of the renal pedicle (from anterior to posterior: vein, artery with renal plexus, renal pelvis).

It is at the level of the transverse process of L1.



URETER: RELATIONS OF ITS ABDOMINAL PORTION (we will study the pelvic portion when we study the urinary bladder)	POSTERIOR	Psoas major, projected over the transverse processes of the three or four last lumbar vertebrae. Genitofemoral nerve.		
	ANTERIOR	Right / left colic and testicular / ovarian vessels (L3). RIGHT URETER (upper portion): Descending part of the duodenum. LEFT URETER (lower portion): Sigmoid mesocolon. The ureter crosses the vertex of its attachment and passes to the posterior wall of the INTERSIGMOID RECESS (a recess inside the peritoneal cavity, bounded by the sigmoid mesocolon).		
	LATERAL	SUPERIOR	Medial border of the kidney	
		INFERIOR	RIGHT	Ascending colon
	LEFT		Descending colon	
MEDIAL	RIGHT	Inferior vena cava		
	LEFT	Ascending part of the duodenum, aorta and inferior mesenteric artery.		

Like the calyces and the renal pelvis, the wall of the ureter is composed of an external **adventitia**, a smooth **double muscle layer** (circular and longitudinal, although they are not easily differentiated) and an inner **mucosal layer**. The mucosal layer consists of a **urothelium or transitional epithelium** (you will study this in Histology) and an underlying connective tissue **lamina propria**.



ARTERIES OF THE URETER: superior, middle and inferior ureteric arteries

The ureter is supplied by branches from the renal, gonadal, common iliac, internal iliac, vesical and uterine arteries, and the abdominal aorta. The pattern of distribution is subject to much variation. The abdominal ureter is supplied from vessels originating medial to the ureter, while the pelvic ureter is supplied by vessels lateral to the ureter. There are longitudinal anastomosis between these branches on the wall of the ureter. The branches from the inferior vesical artery (**inferior ureteric arteries**) are constant in their occurrence and supply the lower part of the ureter. The branch from the renal artery (**superior ureteric artery**) is also constant and is preserved whenever possible in renal transplantation to ensure good vascularity of the ureter. The branches from the gonadal artery are termed **middle ureteric arteries**. Veins are parallel to the arteries.

ENDOCRINE GLANDS: ADRENAL GLANDS

Endocrine glands are glands which secrete their products, hormones, directly into the blood rather than through a duct. The main endocrine glands include the hypophysis, the pineal gland, pancreas, ovaries/testes, thyroid gland, and **adrenal glands**.

The **suprarenal (adrenal) glands** lie immediately superior and slightly anterior to the upper pole of either kidney.

The **right gland** is pyramidal in shape and has two well developed lower projections (limbs) giving a cross-sectional appearance similar to a broad-headed arrow. The bulk of the right suprarenal sits on the apex of the right kidney and usually lies slightly higher than the left gland.

The **left gland** has a more semilunar form and is flattened in the anteroposterior plane. The left gland is marginally larger than the right, and sits on the anteromedial aspect of the upper pole of the left kidney.

The left adrenal gland, like the left kidney, is at the posterior wall of the bursa omentalis.

ADRENAL GLANDS: BLOOD SUPPLY

The **SUPERIOR SUPRARENAL ARTERY** arises from the **inferior phrenic artery**, a branch of the abdominal aorta.

The **MIDDLE SUPRARENAL ARTERY** arises from the lateral aspect of the **abdominal**. The right middle suprarenal artery passes behind the inferior vena cava.

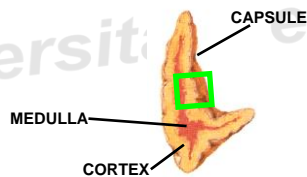
The **INFERIOR SUPRARENAL ARTERIES** arise from the **renal arteries**.

Medullary veins emerge from the hilum to form a **suprarenal vein**, which is usually single. The **RIGHT VEIN** is very short, passing directly and horizontally into the posterior aspect of the **inferior vena cava**. The **LEFT SUPRARENAL VEIN** drains into the **left renal vein**.

ADRENAL GLAND: MICROSTRUCTURE

Each gland possesses two functionally and structurally distinct areas, an outer **cortex** and an inner **medulla** (you already know about the medulla). The gland has also a thick collagenous **capsule**.

The **SUPRARENAL CORTEX** consists of the zona glomerulosa, zona fasciculata and zona reticularis. Cells in the outer subcapsular **zona glomerulosa** produce mineralocorticoids, e.g. aldosterone, which regulates electrolyte and water balance; cells in the broader intermediate **zona fasciculata** produce hormones maintaining carbohydrate balance (glucocorticoids) e.g. cortisol, cells in the innermost part of the cortex, **zona reticularis**, produce sex hormones (progesterone, oestrogens and androgens). The cortex is essential to life and its complete removal is lethal without replacement therapy.



VISCERAL ANATOMY OF THE ABDOMEN

PERITONEAL SPACES

The **SUPRAMESOCOLIC SPACE** lies above the transverse mesocolon, between the diaphragm and the transverse colon. It can be arbitrarily divided into several subspaces. The most important ones are the right subphrenic space, the left subphrenic space and the bursa omentalis.

The **right subphrenic space** lies between the diaphragm and the right lobe of the liver. It is bounded on the left side by the falciform ligament and behind by the coronary ligament.

The **left subphrenic space** lies between the diaphragm, the left lobe of the liver, the anterosuperior surface of the stomach and the diaphragmatic surface of the spleen. It is bounded to the right by the falciform ligament and behind by the left triangular ligament.

The **INFRAMESOCOLIC SPACE** lies below the transverse mesocolon and transverse colon as far as the true pelvis. It is divided in two unequal spaces by the root of the mesentery of the small intestine: the **right infracolic** and the **left infracolic** spaces. It contains the **right and left paracolic gutters** lateral to the ascending and descending colon, between them and the lateral abdominal walls. Both paracolic gutters allow communication between the supra and inframesocolic spaces, bypassing the transverse mesocolon.

ABDOMINAL PERITONEAL SPACES

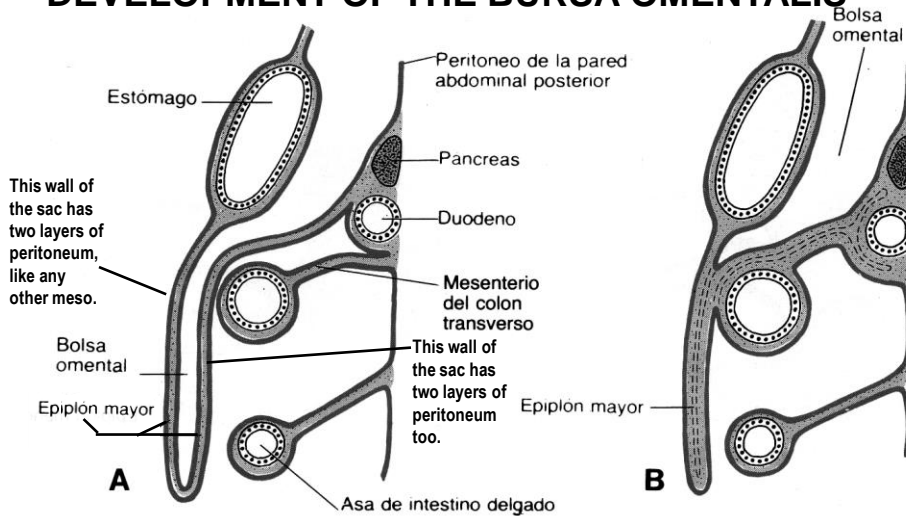
BURSA OMENTALIS (LESSER SAC): BOUNDARIES

ANTERIOR WALL	Lesser omentum, posterior surface of the stomach, and inferiorly the gastrocolic ligament.
POSTERIOR WALL	Posterior abdominal wall, with retroperitoneal and secondarily retroperitoneal viscera. Pancreas, left kidney and adrenal gland, abdominal aorta and the first portion of the branches of the coeliac trunk.
SUPERIOR BORDER	Liver (caudate lobe)
INFERIOR BORDER	Transverse mesocolon
LEFT BORDER	Splenic recess: gastrosplenic and splenorenal ligaments.
RIGHT BORDER	Entry: EPIPLOIC FORAMEN (foramen of Winslow)

BOUNDARIES OF THE EPIPLOIC FORAMEN (OF WINSLOW)

ANTERIOR	Hepatoduodenal ligament (thickened right edge of the lesser omentum), containing the hepatic pedicle: common bile duct, portal vein and hepatic artery.
POSTERIOR	Inferior vena cava
SUPERIOR	Liver (caudate lobe)
INFERIOR	The superior or first portion of the duodenum.

DEVELOPMENT OF THE BURSA OMENTALIS



Remember the development of the bursa omentalis: the rotation of the stomach sequestered the right part of the abdominal cavity posteriorly, between the stomach and the posterior abdominal wall. Between the stomach and the spleen we had the greater omentum, which was going to grow a lot and fell anterior to the transverse colon and the small bowel loops. See in the figure how at first the growth of the greater omentum formed a long sac, which, in fact, was a prolongation of the bursa omentalis (figure A). The walls of this sac got adhered to each other and to the transverse colon and its mesocolon (figure B), forming the gastrocolic ligament from the stomach to the transverse colon and the greater omentum proper ("gran delantal" in Spanish) below the transverse colon. How many layers formed the greater omentum proper, then? **Four**: two layers of peritoneum from one wall of the primitive sac, and two from the other.

- 1: RIGHT HYPOCHONDRILIUM, with liver, gallbladder, cystic point.
- 2: EPIGASTRIUM, with left hepatic lobe, stomach, head and body of pancreas.
- 3: LEFT HYPOCHONDRILIUM, with tail of pancreas, spleen.
- 4: RIGHT LUMBAR REGION, with ascending colon.
- 5: MESOGASTRIUM, CENTRAL or UMBILICAL REGION, with loops of small intestine, transverse colon and greater omentum.
- 6: LEFT LUMBAR REGION, with descending colon.
- 7: RIGHT ILIAC FOSSA, with right ovary/uterine tube, vermiform appendix and caecum.
- 8: HYPOGASTRIUM or SUPRAPUBIC REGION, with urinary bladder and uterus.
- 9: LEFT ILIAC FOSSA, with left ovary/uterine tube, sigmoid colon.

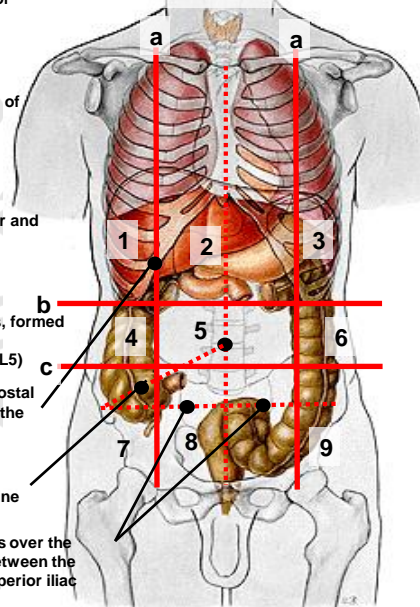
REGIONS OF THE ABDOMEN

- a: midclavicular or mammary line
- b: subcostal plane (it joins the lowest point of the costal margins, formed by the tenth costal cartilage on each side. L3)
- c: transtuberular plane (itjoins the tubercles of the iliac crests. L5)

CYSTIC POINT (projection of the gallbladder), behind the ninth costal cartilage where the lateral edge of the right rectus abdominis (or the right midclavicular/mammary line, which is approximately corresponding) crosses the costal margin.

McBURNEY POINT (projection of the vermiform appendix), at the union between the external and the middle thirds of the oblique line joining the right anterior-superior iliac spine to the umbilicus.

URETERIC POINT (projection of the point where the ureter passes over the pelvic brim as it crosses the common iliac artery), at the union between the external and the middle thirds of the line joining both anterior-superior iliac spines.



Author: Daniel Sánchez Zurriaga (Universitat de València)

PELVIC VISCERAL ANATOMY:

BLADDER AND URETHRA

BLADDER: MORPHOLOGY AND RELATIONS (underlined: VESICAL CELL boundaries)

ABOVE	<p>The superior surface is triangular: it goes from the vertex (URACHUS) anteriorly to the entries of the ureters posteriorly.</p> <p>Covered by <u>PERITONEUM</u>. Through it, intestinal loops and sigmoid colon.</p> <p>In women, it is related to the body of the uterus. Peritoneum between bladder and uterus forms the vesicouterine pouch.</p>
ANTERIOR AND BELOW	<p>The ANTERIOR surface of the bladder has anteriorly the RETROPUBIC space (of RETZIUS). And anterior to it, the pubic symphysis.</p>
BEHIND AND BELOW	<p>The posteroinferior surface of bladder is its base.</p> <p>-in WOMEN, it relates to the neck of the uterus and the anterior wall of the vagina, with the anterior vaginal fornix.</p> <p>-in MEN, it relates to the RECTUM, from which it is separated by (top to bottom): a peritoneal fold (rectovesical pouch), seminal vesicle and vasa deferentia (interdeferential triangle), <u>rectovesical septum or prostatoperitoneal fascia (of Denonvillier's)</u>, PROSTATE.</p>
AT BOTH SIDES	<p>Lateral borders of the bladder are surrounded by the fibrosed umbilical artery.</p> <p>-in WOMEN, at the level of the neck, PUBOVESICAL ligaments, and fibres of the pubococcygeus muscle (pubovesical muscle)</p> <p>-in MEN, vasa deferentia. At the level of the neck, prostate.</p> <p>In both sexes, more laterally, the lateral walls of the pelvis: between this and the bladder, <u>PARACYSTIUM</u>.</p>
INFERIOR EXTREME	<p>It is the NECK of the bladder. It forms the inner os of the urethra.</p> <p>-in men, it is related to the prostate and has the internal urethral sphincter.</p> <p>-in women, it is related to the urogenital diaphragm.</p>

SYMPATHETIC: from the lumbar portion of the sympathetic trunk → lumbar splanchnic nerves → superior and inferior hypogastric plexuses

FUNCTION: vasomotor, contraction of the internal sphincter in males (PREVENTS RETROGRADE EJACULATION)

PARASYMPATHETIC: from the sacral centre → → pelvic splanchnic nerves → inferior hypogastric plexus

FUNCTION: detrusor contraction (MICTURITION)

BLADDER: INNERVATION

VOLUNTARY SOMATIC: pudendal nerve → perineal nerve

FUNCTION: innervation of the urethra's external sphincter (CONTINENCE)

FEMALE URETHRA

PORTIONS: intrapelvic (down to the urogenital diaphragm) and extrapelvic (beyond it).

IRRIGATION: branches of the vaginal artery and the internal pudendal artery (urethral artery).

MALE URETHRA

IRRIGATION: branches of the arteries, which irrigate the prostate and the penis. Inferior vesical, urethral and dorsal artery of the penis.

Author: Daniel Sánchez Zurruga (Universitat de València)

PELVIS VISCERAL ANATOMY:

RECTUM

RECTUM: RELATIONS

ANTERIOR	Above the peritoneum	Covered by peritoneum. Related with: -MALE SEX: superior surface of the BLADDER and seminal vesicles, rectovesical pouch with bowel loops. -FEMALE SEX: uterus, superior portion of the VAGINA , rectouterine (Douglas) pouch with bowel loops.
	Below the peritoneum	-MALE SEX: base of the bladder and seminal vesicles, vas deferens, end of ureter and PROSTATE (fixation: rectovesical septum or Denonvillier's prostatoperitoneal fascia). -FEMALE SEX: inferior portion of the VAGINA .
POSTERIOR		Three last SACRAL VERTEBRAE , coccyx, sacral vessels and nerves, branches of superior rectal vessels, levator ani muscle.
LATERAL	Above the peritoneum	Covered by peritoneum. It is related to the peritoneal pararectal fossa and its contents (sigmoid colon, ileal loops).
	Below the peritoneum	Pelvic autonomic plexus, branches of rectal vessels (fixation: lateral ligament of the rectum), levator ani muscle. Ureter. Further out, lateral pelvic wall: between this and rectum, PARAPROCTIUM .

RECTUM: INNERVATION

SYMPATHETIC: from the lumbar portion of the sympathetic trunk → lumbar splanchnic nerves → superior and inferior hypogastric plexus and arterial plexuses.

Function: VASOMOTOR, bowel relaxation, internal sphincter contraction.

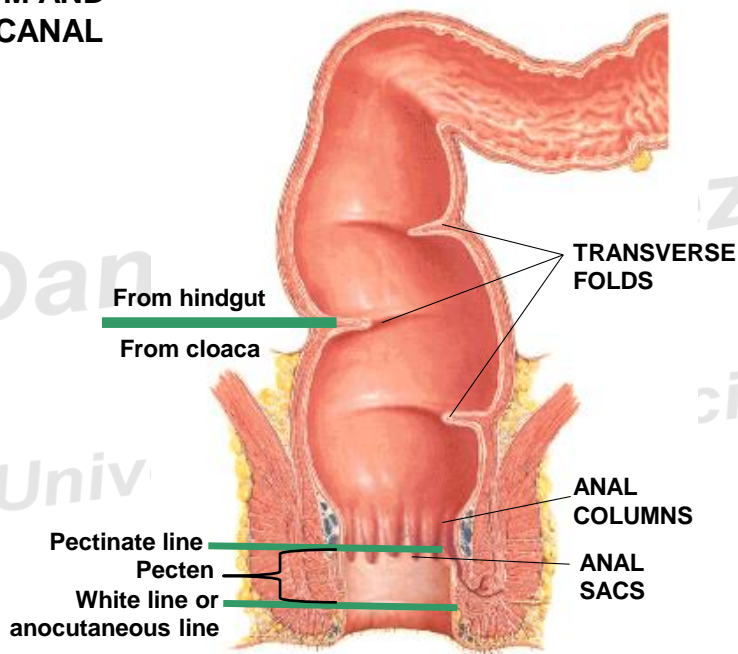
PARASYMPATHETIC: from sacral centre → pelvic splanchnic nerve → inferior hypogastric plexus.

FUNCTION: MOTOR, bowel contraction, internal sphincter relaxation.

SOMATIC VOLUNTARY: from pudendal nerve → inferior rectal nerve.

FUNCTION: external sphincter innervation.

RECTUM AND ANAL CANAL



PELVIS VISCERAL ANATOMY:
FEMALE GENITAL SYSTEM.
UTERUS, OVARIES, FALLOPIAN
TUBES, VAGINA AND VULVA.

UTERUS: RELATIONS

ANTERIOR AND BELOW	<p>The infero-anterior or vesical side of the uterus corresponds to the uterine body and is covered by peritoneum. It is related to the urinary bladder (vesicouterine pouch).</p>
POSTERIOR AND ABOVE	<p>The supero-posterior or intestinal side of the uterus is covered by the peritoneum. At this level, the peritoneum covers the uterine body, cervix and the upper part of the vagina. Bowel loops and the sigmoid colon rest on top of this side of the uterus. At the cervix level, posteriorly, the uterus is related to the rectum (rectouterine or Douglas pouch). Between the cervix and the rectum, the rectouterine folds are located, on each side, bounding laterally the pouch of Douglas.</p>
AT THE SIDES	<p>Broad ligament of the uterus. At the cervix level, transverse cervical ligament of Mackenrodt, accompanying the uterine artery. At this level, the artery crosses anterior to the ureter.</p>
LATERAL ANGLES	<p>Fallopian tubes. Round ligament of uterus. Utero-ovarian ligament or proper ovarian ligament.</p>

OVARY: RELATIONS

LATERALLY	Parietal peritoneum, in the ovarian fossa (or more posterior in multiparous women).
ANTERIOR	The anterior border is called the MESOVARIAN border. The mesovarium attaches to it and joins the ovary to the posterior side of the broad ligament. Through this border, the vascularization and the innervation enter the ovary.
BEHIND	Nothing. The posterior border is a free border.
TUBAL EXTREMITY (upper lateral)	It is higher. It is covered by the uterine tube. The suspensory ligament, the tubo-ovarian ligament and the ovarian fimbria are attached to it.
UTERINE EXTREMITY (medial)	It's lower. The utero-ovarian ligament is attached to it.

OVARY LAYERS

Author:
GERMINAL EPITHELIUM

TUNICA ALBUGINEA

CORTEX (with follicles)

MEDULLA (with vessels and connective tissue)

VASCULARIZATION OF THE UTERUS, TUBE AND VAGINA

MEDIAL TUBAL BRANCH OF THE UTERINE ARTERY

LATERAL TUBAL BRANCH OF THE OVARIAN ARTERY

OVARIAN ARTERY

OVARIAN BRANCH OF THE UTERINE ARTERY

UTERINE ARTERY

OVARIAN VEINS

RIGHT OVARIAN VEIN (to the inferior vena cava)

LEFT OVARIAN VEIN (to the left renal vein)

**Ovarian vascularization goes inside the SUSPENSORY
LIGAMENT OF THE OVARY**

VAGINA: RELATIONS

ANTERIOR	<p>Posteroinferior side of the bladder on top, at the point where the ureters enter.</p> <p>The urethra below that (the urethra is very close to the vaginal anterior wall) .</p>
POSTERIOR	<p>-The highest portion: peritoneum of the pouch of Douglas (CULDOCENTESIS).</p> <p>-Middle portion: rectum.</p> <p>-Lowest portion: urogenital diaphragm.</p>
AT THE SIDES	<p>Pelvic portion of the vagina (upper two-thirds): vessels, ureter (PARACOLPOS).</p> <p>Perineal portion: levator ani, transversus perinei profundus, structures of the vaginal vestibule.</p>
ABOVE	<p>Uterus cervix, called "fish mouth" (vaginal FORNIX).</p>

IRRIGATION: Superior portion: vaginal branches of the uterine artery.

Inferior portion: vaginal artery (branch of the internal iliac artery) and branches of the internal pudendal.

Posterior portion: middle rectal artery.

FIRST BRANCHES OF FEMORAL ARTERY

External pudendal arteries irrigate the labia majora and minora (woman) or the anterior part of the scrotum (man).

**VULVA:
INNERVATION**

ILIOINGUINAL NERVE

Provides innervation to mons veneris and anterior part of labia majora.

POSTERIOR FEMORAL CUTANEOUS NERVE

Provides innervation to lateral part of labia majora.

PERINEAL NERVE

Provides innervation to the posterior side of labia majora, all labia minora, bulb of vestibule.

PUDENDAL NERVE

**Author:
PELVIS VISCERAL ANATOMY:**

**Daniel Sánchez
Zuriaga
MALE GENITAL SYSTEM:
PROSTATE, PENIS
(Universitat de València)**

PROSTATE: RELATIONS (underlined: limits of the PROSTATIC CELL)

ABOVE	Its superior surface is the BASE or vesical surface. It is related to the <u>bladder's neck</u> (urethra's entrance).
BELOW	The prostatic APEX is below (urethra's exit). It is related to the <u>fascia covering the upper face of the urethra's external sphincter and the transversus perinei profundus.</u>
OPPOSITE	The anterior surface is separated from the pubic symphysis by the anterior portion of the prostatic venous plexus (Santorini's), adipose tissue and the <u>PRE-PROSTATIC FASCIA</u> . In the upper part it is bonded to both pubic bones by the <u>PUBOPROSTATIC ligaments</u> .
BEHIND	The posterior surface is linked to the rectum through the <u>rectovesical membrane or Denonvillier's prostatoperitoneal aponeurosis</u> . The entrance of the ejaculatory ducts is at the superior portion of the posterior surface.
AT BOTH SIDES	Laterally and below, the prostate is related to the levator ani. It is separated from it by conjunctive tissue and the lateral part of the prostatic venous plexus (Santorini's), creating all together the <u>PROSTATIC FASCIA</u> .

PROSTATE: IRRIGATION

ARTERIES: all from the **INTERNAL ILIAC**

- Above all, the **INFERIOR VESICAL**
- Middle rectal
- Internal pudendal
- Prostatic (inconstant)

VEINS:

- They form a plexus around the anterior and lateral surfaces of the prostate:
- ANTEROLATERAL PLEXUS OR SANTORINI'S.**
- The **PENIS DEEP DORSAL VEIN** also drains to it.
- It is communicated with the vertebral venous plexuses
- prostatic cancer extension.

MALE URETHRA

Author:

Daniel Sánchez
Zuriaga
(Universitat de València)

PREPROSTATIC

PROSTATIC

MEMBRANOUS

SPONGY or ANTERIOR

Bulbar

Penile or pendulous

PENIS

GLANS

Urinary meatus

Glans crown with
preputial glands
(smegma)

Penis neck

Prepuce

Frenulum

BODY

ROOT

Author:
Daniel Sánchez
Zuriaga
(Universitat de València)

PENILE NERVES. NERVOUS CONTROL OF ERECTION

SYMPATHETIC: from the lumbar and sacral portion of the sympathetic trunk → lumbar and sacral splanchnic nerves → superior and inferior hypogastric plexus, prostatic plexus → penis cavernous nerves

Function: TO DISCHARGE GLANDULAR SECRETION, ejaculation, detumescence.

PARASYMPATHETIC: from the sacral centre → pelvic splanchnic nerves → superior and inferior hypogastric plexus, prostatic plexus → penis cavernous nerves

FUNCTION: vasodilation, and ERECTION as a consequence.

SOMATIC VOLUNTARY: of the pudendal nerve → perineal nerve

FUNCTION: innervation of the ischiocavernosus and the bulbospongiosus muscles → they cooperate with erection (both) and ejaculation (bulbospongiosus).

ANATOMY OF THE PELVIC

VISCERA :

**INTERNAL ILIAC VESSELS .
URETER'S PELVIC PATHWAY.
PELVIVISCERAL SPACES.**

BRANCHES OF THE INTERNAL ILIAC ARTERY

- **POSTERIOR TRUNK:** originates only **PARIETAL** branches, intrapelvic (lateral sacral, Iliolumbar) and extra pelvic (superior gluteal).
 - **Iliolumbar.** It is ascendant. It is divided into one *lumbar* branch (for psoas, quadratus lumborum) and one *iliac* (for iliacus).
 - **Lateral sacral.** With one *superior* (ascendant) and other *inferior* (more important, descendant). Both branches are located on one side of the middle sacral artery.
 - **Superior Gluteal.** It continues the posterior trunk. It comes out of the pelvis through the suprapiriform orifice.
- **ANTERIOR TRUNK:** originates **EXTRAPELVIC PARIETAL** branches (obturator, inferior gluteal, internal pudendal) and **VISCERAL** (all the others).
 - **Superior vesical.** Distally it is continued by the fibrosated **umbilical** artery which forms the *medial umbilical fold*.
 - **Inferior vesical.** With distinctive features according to gender:
 - In women: it is frequently non existent and its territory is irrigated by the vaginal artery.
 - In men: it irrigates part of the bladder, the prostate, the seminal vesicles and the vas deferens through the **deferential artery** (which can also be a branch from the superior vesical). Besides, inferior vesical and middle rectal often originate from a common trunk in men.
 - A **prostatic** artery or a **vesico-deferential** artery may originate as direct branches from the internal iliac.
 - **Middle rectal.** It can be absent, having its territory irrigated by the superior rectal.
 - **Vaginal.** It is usually a branch of the uterine artery.
 - **Obturator.**
 - **Uterine.** With branches for the cervix, vagina, Fallopian tubes and ovary.
 - **Inferior gluteal.** Comes out of the pelvis through the infrapiriform orifice.
 - **Internal pudendal.** Satellite of the pudendal nerve. It abandons the pelvis through the infrapiriform orifice. It goes around the sciatic spine below the levator ani, at the perineum's level going over the lateral pelvic wall in Alcock's canal. Branches:
 - **Inferior Rectal,** for the anal canal and anal sphincters.
 - **Perineal,** for the urogenital diaphragm and scrotum/labia majora.
 - Arteries for the erectile bodies: **artery of the penis/vagina bulb, cavernous artery or deep artery of the penis/clitoris, dorsal artery of the penis/clitoris.**

URETER PELVIC SEGMENT (from the crossing of the common iliac vessels or external iliac vessels)	PARIETAL segment (the ureter goes posteriorly and laterally)	♂	It descends anterior to the internal iliac artery and medial to its anterior branches.
		♀	Similar to the male, but also forms, together with the internal iliac vessels, the posterior boundary of the OVARIC FOSA. Below that, it positions medial to the uterine artery.
	VISCERAL segment (from the sciatic spine: the ureter goes anteriorly and medially)	♂	It crosses the paraproctium and the paracystium. The vas deferens crosses anterior and superior to the ureter. Below that, we find the superior extreme of the seminal vesicle.
		♀	It crosses through the paraproctium, parametrium / paracolpos and paracystium. The uterine artery crosses the ureter (the uterine artery is anterior to the ureter at this crossing) at the uterine cervix level. Posteriorly, it is related to the anterior wall of the vagina, at the level of the vaginal fornix.

PELVIVISCERAL or SUBPERITONEAL SPACES

SUPERIOR	Peritoneum
INFERIOR	Deep perineal aponeurosis (levator ani)
LATERAL	Pelvic wall, covered by the obturator internus muscle and its aponeurosis.
MEDIAL	<p align="center">Pelvic viscera:</p> <ul style="list-style-type: none"> - Behind, in both sexes: RECTUM (PARAPROCTIUM). - Centrally, in the female: UTERUS (PARAMETRIUM) above and VAGINA (PARACOLPOS) below. - Anteriorly, in both sexes: BLADDER (PARACYSTIUM).
CONTENTS	<ul style="list-style-type: none"> ➤ Obturator vessels and nerves. ➤ Visceral branches of the internal iliac vessels: <ul style="list-style-type: none"> - PARAPROCTIUM: middle rectal vessels - PARAMETRIUM and PARACOLPOS: uterine artery and its vaginal branches. - PARACYSTIUM: vesical arteries. ➤ Sympathetic and parasympathetic innervation: branches of the pelvic splanchnic nerves, inferior hypogastric plexus. ➤ Ureter (at the level of the PARAMETRIUM / PARACOLPOS, the uterine artery crosses anterior to it).

STRUCTURES TO IDENTIFY AT HEAD AND NECK DISSECTION

CADAVER:

- Parotid gland
 - Parotid duct (Stenon)
 - Describe the relationships of the gland (boundaries of the parotid cell).
 - Contents of the gland:
 - ✓ Superficial temporal artery
 - ✓ Retromandibular trunk: anterior and posterior branches
 - ✓ Branches of the facial nerve
- Submandibular gland
 - Deep and superficial portions
 - Submandibular duct (Wharton)
- Sublingual gland
- Tongue muscles
 - Genioglossus
 - Geniohyoid
 - Styloglossus
 - Hyoglossus. Relationships:
 - ✓ Hypoglossal nerve
 - ✓ Lingual nerve
- Mylohyoid
- Digastric muscle
- Lingual nerve
- Larynx
- Thyroid and cricoid cartilages
 - Thyrohyoid and cricothyroid membranes
 - Cricothyroid muscle
 - Vocal fold
 - Vestibular fold
 - Laryngeal ventricle
 - Glottis
- Thyroid gland
 - Superior thyroid artery
 - Describe the relationships of the thyroid lobes: trachea, inferior/recurrent laryngeal nerve, infrahyoid muscles.

ANATOMICAL RECONSTRUCTIONS:

- Laryngeal cartilages
 - Epiglottis
 - Thyroid
 - Cricoid
 - Arytenoids
 - Corniculates
- Cricothyroid and cricoarytenoid joints
- Conus elasticus and quadrangular membrane
- Muscles:
 - Cricothyroid
 - Posterior and lateral cricoarytenoid
 - Vocalis
 - Interarytenoid
- Aryepiglottic fold. Boundaries of the laryngeal aditus
- Supraglottis
 - Piriform sinuses
- Vocal and vestibular folds
 - Laryngeal ventricle
 - Glottis
- Preepiglottic space and fat body
- Superior and inferior/recurrent laryngeal nerves
- Superior and inferior thyroid and laryngeal arteries
- Thyroid gland. Relationships.

STRUCTURES TO IDENTIFY IN THE THORAX DISSECTION SESSIONS (THREE SESSIONS)

FIRST SESSION:

- On the thoracic wall:
 - o Medial thoracic artery
- Pericardial sac:
 - o Boundaries of the cardiac area
 - o Transverse sinus of the pericardium
 - o Oblique sinus of the pericardium
 - o Pericardiophrenic vessels
 - o Phrenic nerve
- Heart:
 - o All the external structures listed when describing the cardiac surfaces and borders:
 - Contents of the anterior/ sternocostal surface
 - Contents of the posterior surface/ base
 - Contents of the inferior/ diaphragmatic surface
 - Contents of the right and left cardiac surfaces
 - Acute margin
 - Obtuse margin
 - Terminal sulcus
 - o Mark the different thicknesses of the myocardial wall in each cavity.
 - o All the internal structures listed when describing the internal morphology of the cardiac cavities:
 - Anterior, posterior, superior, inferior, lateral and medial walls of the atria
 - Right ventricle:
 - ✓ Right atrioventricular valve (tricuspid)
 - ✓ Papillary muscles and tendinous chords
 - ✓ Pulmonary valve
 - ✓ Supraventricular crest
 - ✓ Septomarginal trabecula
 - Left ventricle:
 - ✓ Left atrioventricular valve (mitral)
 - ✓ Papillary muscles and tendinous chords
 - ✓ Aortic valve
 - o The sinuses and vessels of the coronary circulation. **(SECOND SESSION)**
- Ascending aorta, with the origin of the coronary arteries
- Aortic arch
 - o Vagus and left recurrent laryngeal nerves
 - o Branches: supra-aortic trunks
 - Brachiocephalic trunk
 - ✓ Right subclavian artery
 - ✓ Right common carotid artery
 - ✓ Right vagus and recurrent laryngeal nerves
 - Left common carotid artery
 - Left subclavian artery
- Pulmonary trunk
 - o Ligamentum arteriosum
- Superior vena cava
 - o Right brachiocephalic or innominate vein
 - o Left brachiocephalic or innominate vein
- Pulmonary veins
- Trachea

THIRD SESSION:

- Descending thoracic aorta
 - o Parietal branches: posterior intercostal arteries
- Azygos vein
 - o Azygos arch
 - o Branches:
 - Right posterior intercostal veins
 - Right superior intercostal vein
- Accessory hemiazygos vein
 - o Branches: first left posterior intercostal veins
- Hemiazygos vein
 - o Branches: the other left posterior intercostal veins
- Thoracic duct
- Sympathetic trunk
- Splanchnic nerves
- Oesophagus
- Trachea
- Tracheal bifurcation (carina)
- Right main bronchus
 - o Subdivisions
 - Right superior lobar bronchus (eparterial)
 - Middle lobar bronchus
 - Right inferior lobar bronchus
- Left main bronchus
 - o Subdivisions
 - Left superior lobar bronchus
 - Left inferior lobar bronchus
- External morphology of each lung, with their hila, visceral impressions and fissures. Lobes.
- Pulmonary ligament
- Parietal pleura
 - o Cervical pleura
 - o Mediastinal pleura
 - o Vertebrocostal pleura
 - o Diaphragmatic pleura
- Pleural sinuses or recesses
 - o Costodiaphragmatic recess

STRUCTURES TO IDENTIFY AT FIRST ABDOMINAL DISSECTION (liver and coeliac viscera)

LIVER:

- Liver:
 - o Diaphragmatic and visceral surfaces. Relations of each.
 - o Subdivisions:
 - Anatomical: lobes
 - ✓ Right lobe
 - ✓ Left lobe
 - ✓ Falciform ligament
 - ✓ Caudate lobe
 - ✓ Quadrate lobe
 - ✓ Umbilical fissure (round and venous ligaments)
 - ✓ Main portal fissure (gallbladder and inferior vena cava)
 - Functional/surgical: segments. Identify the separations between segments which are visible superficially.
 - o Peritoneum:
 - Bare area
 - Coronary ligaments
 - Right and left triangular ligaments
 - Lesser omentum and hepatoduodenal ligament
 - o Hepatic hilum and pedicles:
 - Branches of the hepatic artery proper
 - Portal vein
 - Biliary tree
 - o Biliary tree:
 - Common hepatic duct
 - Gallbladder. Parts:
 - ✓ Fundus
 - ✓ Body
 - ✓ Infundibulum, Hartmann's pouch
 - ✓ Neck
 - Cystic duct
 - Common bile duct ("conducto colédoco", in Spanish)
 - Cystic artery
 - Calot's triangle

COELIAC VISCERA:

- Coeliac trunk and branches:
 - o Left gastric artery
 - o Common hepatic artery
 - Hepatic artery proper
 - Right gastric artery
 - Gastroduodenal artery

- ✓ Right gastro-omental artery
 - Splenic artery
 - Left gastro-omental artery
- Abdominal oesophagus
- Stomach:
 - Superficial features:
 - Greater and lesser curvatures
 - Cardiac incisura
 - Incisura angularis
 - Sulcus intermedius
 - Parts:
 - Cardias
 - Fundus
 - Body
 - Pyloric antrum
 - Pylorus
- Duodenum:
 - Portions:
 - First or superior
 - Second or descending
 - Third or horizontal
 - Fourth or ascending
- Pancreas:
 - Parts:
 - Head and uncinated process
 - Neck
 - Body
 - Tail
 - Main relations:
 - Superior mesenteric vessels
 - Portal vein
 - Splenic vessels
 - Duodenum
- Spleen:
 - Diaphragmatic and visceral surfaces. Relations of each surface.
 - Splenic hilum, with splenic artery and vein.

Author:
Daniel Sánchez
Zuriaga
(Universitat de València)

STRUCTURES TO IDENTIFY AT THE SECOND ABDOMINAL DISSECTION

(viscera of the midgut and the hindgut, retroperitoneal viscera, abdominal quadrants)

FIRST BLOCK: Midgut and hindgut viscera. Mesenteric arteries.

- Jejunum and ileum
 - Jejunal and ileal loops
 - Vascular arches and vasa recta
 - Root of the mesentery
- Colon
 - Caecum
 - Ileocecal valve
 - Appendix
 - Union of the three taeniae
 - Ascending colon
 - Right (hepatic) colic angle
 - Transverse colon
 - Transverse mesocolon
 - Gastrocolic ligament
 - Greater omentum (“gran delantal”)
 - Left (splenic) colic angle
 - Descending colon
 - Sigmoid colon
 - Sigmoid mesocolon
 - Rectum (superior portion)
 - Haustrations, taeniae and appendices epiploicae: follow their evolution along the colon.
- Peritoneal compartments
 - Supra and inframesocolic spaces
 - Right and left infracolic spaces
 - Right and left paracolic gutters
 - Retrocaecal fossa
 - Intersigmoid fossa
- Mesenteric arteries
 - Superior mesenteric artery
 - Middle colic
 - Right colic
 - Ileocolic (“ileo-biceco-apendiculo-cólica”). Branches:
 - ✓ Ileal
 - ✓ Colic
 - Inferior mesenteric artery
 - Left colic artery, with ascending and descending branches
 - Sigmoid arteries

- Superior rectal

SECOND BLOCK: Retroperitoneal structures

- Abdominal aorta and its branches. Origin and retroperitoneal pathway of the branches of:
 - Coeliac trunk
 - Superior mesenteric
 - Renal
 - Gonadal
 - Inferior mesenteric
 - Common iliac and bifurcation
- Inferior vena cava and its branches
 - Right gonadal vein
 - Renal veins
 - Left gonadal vein
 - Common iliac veins
- Kidney
 - Perirenal fat
 - Renal hilum
 - Renal sinus
 - Renal vein
 - Renal artery
 - Renal pelvis and beginning of the ureter
 - Inner macrostructure of the kidney
 - Renal cortex
 - ✓ Renal columns (Bertin)
 - Renal medulla
 - ✓ Renal pyramids (Malphigi)
 - ✓ Renal papillae
 - Minor and major renal calyces
- Ureter (abdominal pathway)
- Adrenal gland
 - Adrenal vessels

THIRD BLOCK: Abdominal quadrants (uploaded to the Virtual Classroom)

STRUCTURES TO IDENTIFY IN THE PELVIC VISCERA PRACTICAL SESSION (sectioned pelvis, anatomical reconstructions, dissection of the male external genitalia, internal and external female genitalia)

FIRST BLOCK: sectioned pelvis and anatomical reconstructions

- Pubic symphysis
- Urinary bladder*
- Prostate
- Seminal vesicles
- Ureter
- Vas deferens
- Pouches: vesicorectal
 - vesicouterine*
 - uterorectal (Douglas)*
- Uterus*
- Fallopian tube*
- Broad ligament:
 - Mesosalpinx*
 - Mesovarium*
 - Mesometrium*
- Ovary*
- Rectum: *
 - Transverse folds
 - Anal canal
- Sacrum

Author:
Daniel Sánchez
Zuriaga
(Universitat de València)

SECOND BLOCK: abdominal bottom and external genitalia on the female cadaver

The structures to identify at the abdominal bottom are the ones marked with asterisks at the list above.

External genitalia at the female cadaver:

- Vulva
 - Mons veneris
 - Labia majora
 - Labia minora
 - Clitoris
 - Vaginal vestibule
- Perineal raphe
- Anal opening

THIRD BLOCK: dissection of the male external genitalia

- Scrotum: layers (at least identify the cremaster and the vaginal cavity)
- Testicle (tunica albuginea)
- Epididymis
 - Head
 - Body
 - Tail
- Vas deferens
- Pampiniform venous plexus and testicular artery
- Penis
 - Dorsal superficial vein
 - Corpus spongiosum
 - Corpora cavernosa
 - Glans:
 - Crown
 - Neck of the penis
 - Prepuce

FORTH BLOCK: branches of the internal iliac artery (at the sectioned pelvis)

- Iliac artery:
 - Common
 - External
 - Internal. Branches:
 - Posterior trunk. Branches:
 - ✓ Iliolumbar
 - ✓ Lateral sacral
 - ✓ Superior gluteal
 - Anterior trunk. Branches:
 - ✓ Umbilical/ superior vesical
 - ✓ Obturator
 - ✓ Other visceral branches, difficult to identify
 - ✓ Inferior gluteal
 - ✓ Internal pudendal