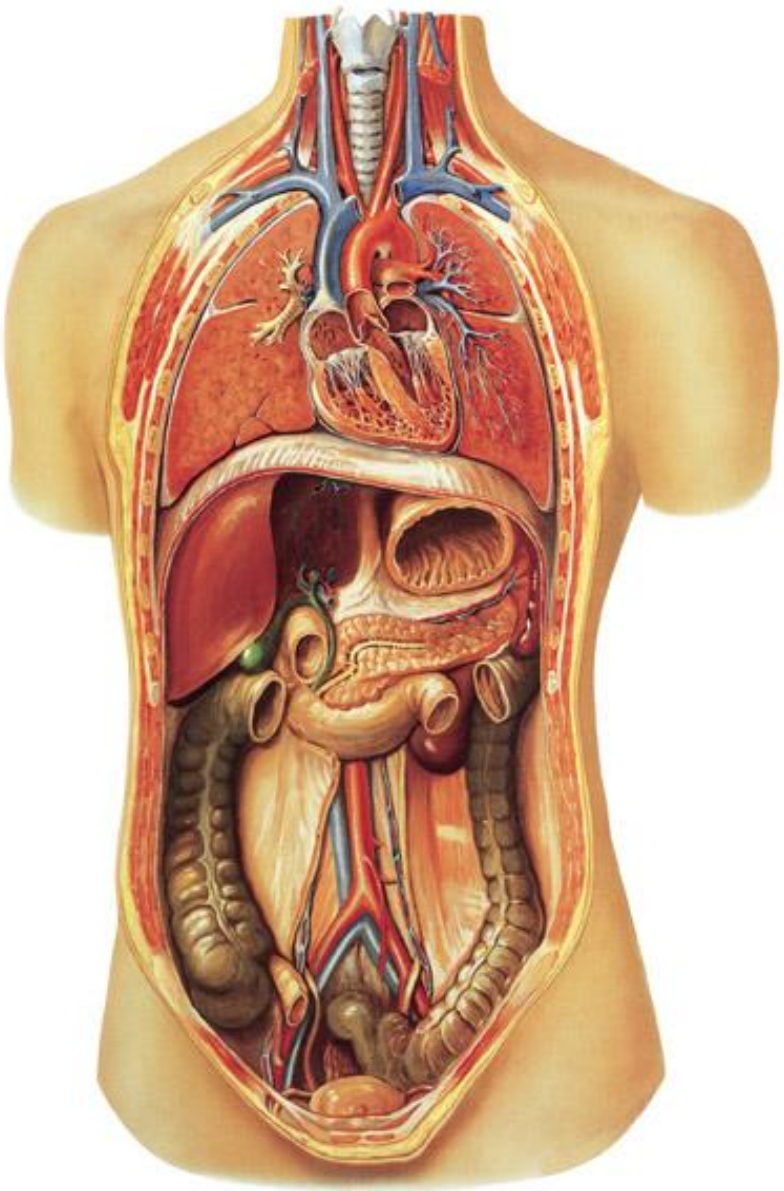
ANATOMY *Group B*

exam notes

by Catarina Bastos (2011)



FACULTAS MEDICA
UNIVERSITATIS MASARYKIANAE BRUNENSIS

Questions B

1. The hard and soft palatum

The palate forms the arched roof of the mouth and the floor of the nasal cavities. It separates the oral cavity from the nasal cavities and the nasopharynx. The superior (nasal) surface of the palate is covered with respiratory mucosa, and the inferior (oral) surface is covered with oral mucosa, densely packed with glands. The palate consists of two regions: the hard palate anteriorly and the soft palate posteriorly.

- Hard palate

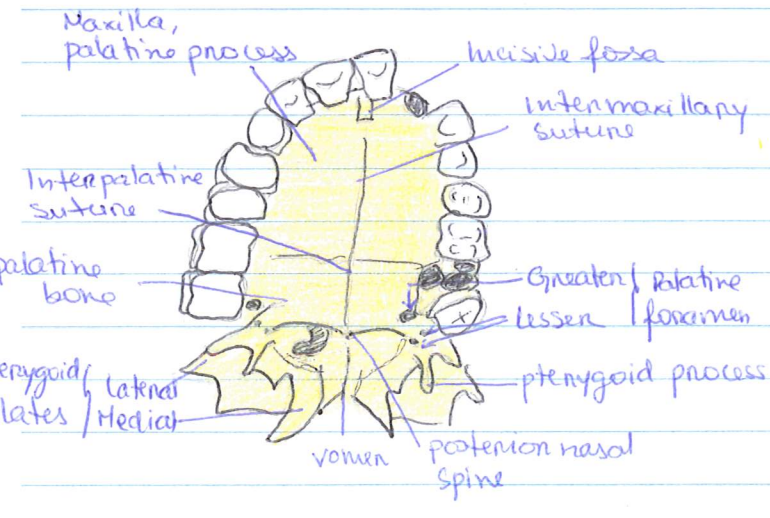
The hard palate is vaulted (concave). The anterior two thirds of the palate has a bony skeleton formed by the palatine processes of the maxillae and the horizontal plates of the palatine bones.

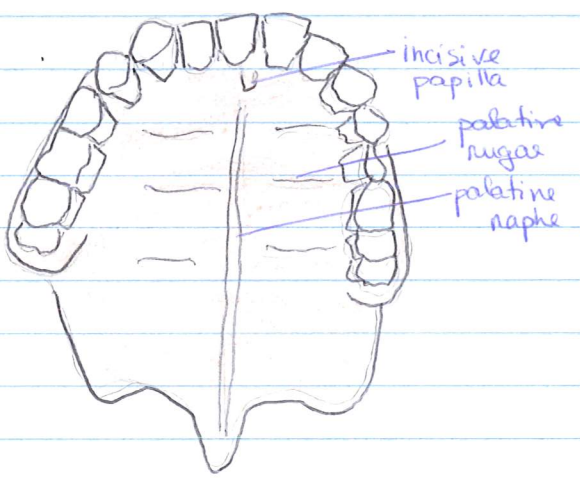
The bones of the hard palate are covered by periosteum and a thick mucosa that is firmly attached to the periosteum and is continuous anteriorly with the gingiva. In the midline there is a mucosal ridge known as the palatine raphe, a tissue elevation that overlies the bony median palatine suture and ends anteriorly in a small eminence known as the incisive papilla. The incisive fossa is a depression in the midline of the bony palate posterior to the central incisor teeth into which the incisive canals open.

On either side of the palatine raphe the mucosa forms flat transverse ridges called palatine rugae.

Medial to the 3rd molar tooth, the greater palatine foramen pierces the lateral border of the bony palate. The greater palatine vessels and nerve emerge from this foramen and run anteriorly on the palate. The lesser palatine foramina posterior to the greater palatine foramen pierce the pyramidal process of the palatine bone. These foramina transmit the lesser palatine nerves and vessels to the soft palate and adjacent structures.

Lying to the right and left of the midline, in the posterior portion of the mucosal lining of the hard palate, are small mucous-secreting palatine glands which produce saliva that lubricates ingested food.





- Soft palate

The soft palate is the movable posterior third of the palate and is the movable posterior third of the palate and is suspended from the posterior border of the hard palate. The soft palate has no bony skeleton; however, its anterior aponeurotic part is strengthened by the palatine aponeurosis, which attaches to the posterior edge of the hard palate.

Posteroinferiorly, the soft palate has a curved free margin from which hangs a conical process, the uvula.

When a person swallows, the soft palate initially is tensed to allow the tongue to press against it, squeezing the bolus of food to the back of the mouth. The soft palate is then elevated posteriorly and superiorly against the wall of the pharynx, thereby preventing passage of food into the nasal cavity.

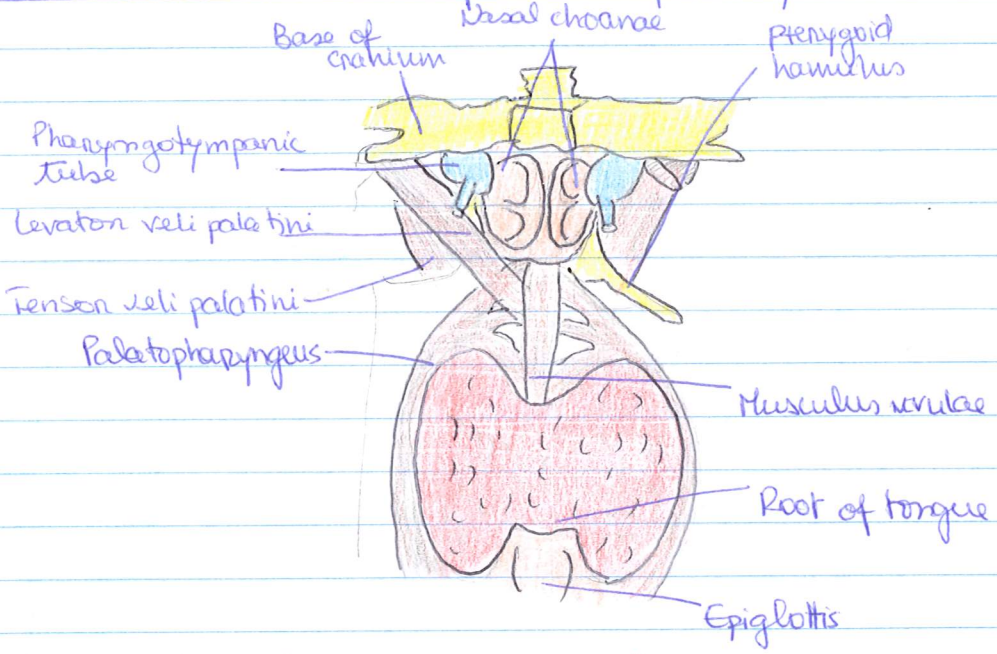
Laterally, the soft palate is continuous with the wall of the pharynx and is joined to the tongue and pharynx by the palatoglossal and palatopharyngeal arches, respectively.

The fauces is the space between the cavity of the mouth and the pharynx. The fauces is bounded superiorly by the soft palate, inferiorly by the root of the tongue, and laterally by the pillars of the fauces, the palatoglossal and palatopharyngeal arches. The isthmus of the fauces is the short constricted space that establishes the connection between the oral cavity proper and the oropharynx. The mucosa and glands of the hard palate are continuous with those of the soft palate.

Muscles of the soft palate

MUSCLE	ORIGIN	INSERTION	INNERVATION
Tensor veli palatini	Scaphoid fossa of medial plate, spine of sphenoidal bone, and cartilage of pharyngotympanic tube	Palatine aponeurosis	Medial pterygoid nerve (a branch of mandibular nerve, V_3)
FUNCTION: Tenses soft palate and opens mouth of pharyngotympanic tube during swallowing and yawning			
Levator veli palatini	Cartilage of pharyngotympanic tube and petrous part of temporal bone	Palatine aponeurosis	Pharyngeal branch of vagal nerve (X) Glossopharyngeal nerve (IX)
FUNCTION: elevates soft palate during swallowing and yawning			

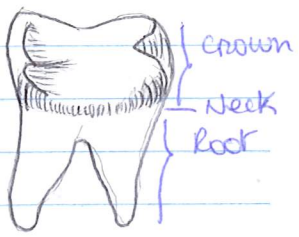
MUSCLE	ORIGIN	INSERTION	INNERVATION
Palatoglossus	Palatine aponeurosis	Side of tongue	Pharyngeal branch of Glossopharyngeal vagus nerve (IX)
FUNCTION: elevates posterior part of tongue and draws soft palate onto tongue			
Palatopharyngeus	Hard palate and palatine aponeurosis	Lateral wall of pharynx	Pharyngeal branch of Glossopharyngeal vagus nerve (IX)
FUNCTION: Tenses soft palate and pulls walls of pharynx superiorly, anteriorly and medially during swallowing			
Uvulae	Posterior nasal spine and palatine aponeurosis	Mucosa of uvula	Pharyngeal branch of Glossopharyngeal vagus nerve (IX)
FUNCTION: shortens uvula and pulls it superiorly			



2. The teeth (dentes) - description, types, the gingivae

In human dentition, the teeth are contained in the bony sockets of the mandible and maxilla. Humans have heterodont dentition, that is, individual teeth are shaped differently according to function.

Tooth segments - Each tooth can be divided into 3 segments: a crown, a neck and a root. The root is that part of the tooth which lies in the bony socket and is secured by the periodontium. The neck of the tooth describes the narrow junction between the crown and root, it projects above the socket, but is covered by the gingiva.



The crown is the part of the tooth visible above the gingiva. Several surfaces may be distinguished: the occlusal surface which has contact with the tooth in the opposing dental arcade; the vestibular surface facing the lips or cheeks; the lingual surface or palatal surface, namely the inner surface; and the approximal surface facing the adjacent tooth.

The maxillary dental arcade is shaped like a half of an ellipse while the mandibular dental arcade is shaped like a parabola.

If the dental arcade is divide in half along the median plane, the teeth of one half are arranged in the mirror image of those of the other half. From mesial to distal they are: the two incisor teeth, followed by one canine tooth, then two premolar teeth and finally three molar teeth (4 x 8 = 32 teeth). ← in adults

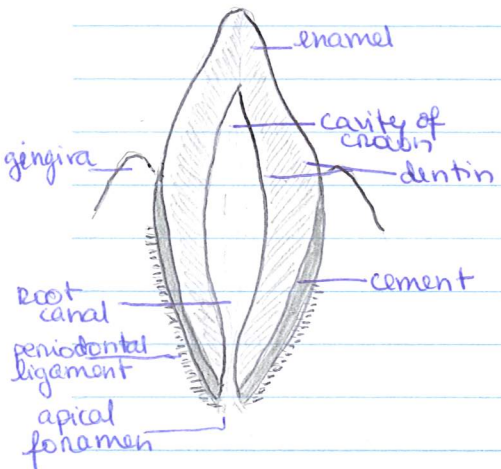
Functional anatomy ⇒ The incisor teeth are used for biting and have a chisel-shaped crown with a horizontal cutting edge. The incisor tooth has a single, long, conical root. The canine teeth are used for tearing and grasping. Each canine tooth has two cutting edges, a cusp tip, and a single, very long root. The premolar teeth are used for grinding food. Each premolar tooth has two cusps. The roots of the upper premolar teeth are divided while the lower premolars have simple roots. The molar teeth are responsible for the bulk of chewing. Their occlusal surfaces have 4 cusps each. The molar teeth of the maxilla have three roots each and those of the mandible have two roots each.

Dental formula ⇒ numbering teeth by quadrants beginning from the upper right quadrant with 1-4 then numbering the teeth from mesial to distal as 1-8.

- Right maxillary quadrant: 11, 12, 13, 14, 15, 16, 17, 18
- Left maxillary quadrant: 21, 22, 23, 24, 25, 26, 27, 28
- Left mandibular quadrant: 31, 32, 33, 34, 35, 36, 37, 38
- Right mandibular quadrant: 41, 42, 43, 44, 45, 46, 47, 48

In children, quadrants are numbered 5-8 and teeth I - V

Parts of the tooth and the periodontium - The bulk of the tooth consists of dentin surrounding a pulp cavity. The cavity consists of the pulp cavity of crown, the root canal and the apical foramen, an opening at the tip of the root. The portion of the dentin in the tooth crown is surrounded by enamel and the dentin of the tooth root is covered by cement. The enamel and cement meet at the neck of the tooth. The tooth in the bony socket is held by a fibrous periodontal ligament. Together the periodontal fibers, cement, gingiva and alveolar wall are collectively known as the paradontium.



Gingivae - The gingivae (gums) are composed of fibrous tissue covered with mucous membrane. The gingiva proper (attached gingiva) is firmly attached to the alveolar processes of the mandible and maxilla and the neck of the teeth. The gingiva proper adjacent to the tongue is the superior and inferior lingual gingivae, and that adjacent to the lips and cheeks is the maxillary and mandibular labial

on buccal gingiva, respectively. The gingiva proper is normally pink, stippled, and keratinizing. The alveolar mucosa (unattached gingiva) is normally shiny red and non-keratinizing.

3. The dentition, eruption

Deciduous teeth → The entire dental arcade contains a total of 20 teeth with each half of the dental arch holding two incisor teeth, one canine tooth, and two primary molars. The shape of the primary teeth resembles that of the permanent teeth. The dentin is thinner and less durable than that of the permanent teeth.

Dental formula for deciduous teeth → the first digit (5-8) corresponds to the quadrants from upper right to lower right and the second digit (-) identifies the teeth from mesial to distal:

- Right maxillary quadrant: 5, 5, 5, 5, 5
- left maxillary quadrant: 6, 6, 6, 6, 6
- left mandibular quadrant: 7, 7, 7, 7, 7
- Right mandibular quadrant: 8, 8, 8, 8, 8

Deciduous Teeth	Central Incisor	Lateral Incisor	Canine	1st Molar	2nd Molar
Eruption (month)	6-8	8-12	16-20	12-16	20-36
Shedding (year)	6-7	7-8	10-12	9-11	10-12

Permanent Teeth	Central Incisor	Lateral Incisor	Canine	1st Pre-Molar	2nd Pre-Molar	1st Molar	2nd Molar	3rd Molar
Eruption (year)	7-8	8-9	11-13	9-11	11-13	6-7	12-14	17-40

4. The salivary glands

The ducts from numerous small salivary glands known as the minor salivary glands as well as those from the three paired major salivary glands drain into the oral cavity.

The clear, tasteless, odorless viscid fluid, saliva, secreted by these glands and the mucous glands of the oral cavity:

- Keeps the mucous membrane of the mouth moist
- lubricates the food during mastication
- Begins the digestion of starches
- Serves as an intrinsic "mouthwash"
- Plays significant roles in the prevention of tooth decay and in the ability to taste.

✓ Minor Salivary Glands → The minor salivary glands include the "packages" of glandular tissues lying in the mucosa of the lips, cheeks, tongue, and palate containing mucous secretory units as well as the anterior lingual glands which are located in the tip of the tongue, sometimes on the underside of its of its apex.

→ Major Salivary Glands

◦ PAROTID GLAND

The purely serous parotid gland is the largest of the salivary glands. Is enclosed within a though, unyielding fascial capsule, the parotid sheath (parotidomasseterica), derived from the investing layer of deep cervical fascia. It lies in front of the external acoustic meatus on the posterior part of the masseter. The parotid gland extends superiorly to the zygomatic arch inferiorly to the angle of the mandible and deeply, behind the ramus of the mandible in the retromandibular fossa.

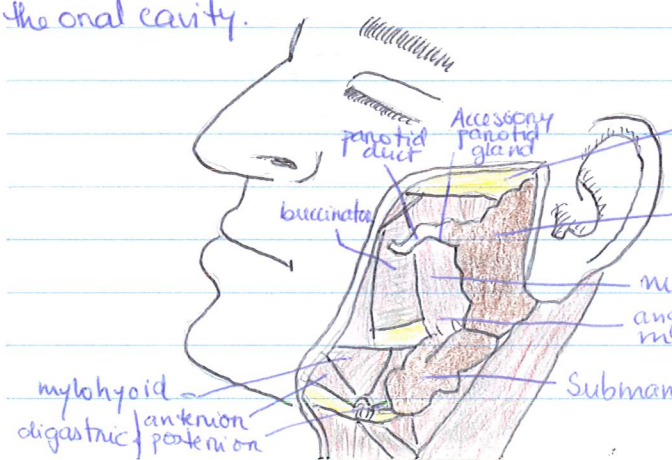
The 3-4 mm thick parotid duct projects from the anterior border of the gland and passes parallel to the zygomatic arch over the masseter and buccal fat pad, penetrating the buccinator and opening in the oral vestibule at the level of the upper second molar tooth on the parotid papilla. A small accessory parotid gland often lies adjacent to the duct.

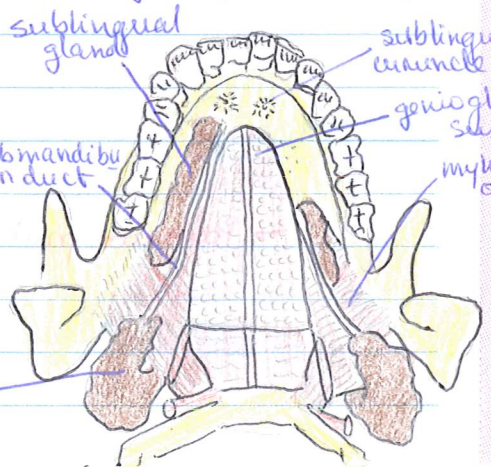
◦ SUBMANDIBULAR GLAND

The predominantly serous submandibular gland lies in the submandibular triangle which is bounded by the mandible and the anterior and the posterior bellies of the digastric muscle. The body of the gland is enclosed in a capsule and lies under the mylohyoid, extending deeply to the hyoglossus and styloglossus. The submandibular duct is accompany by a hook-like process of glandular tissue. It travels along the superior surface of the posterior border of the mylohyoid, then passes forward, medial to the sublingual caruncle.

◦ SUBLINGUAL GLAND

The predominantly mucous sublingual gland lies on the mylohyoid and produces the sublingual fold. It extends laterally as far as the mandible and medially to the genioglossus. The duct of the principal gland of the sublingual gland complex, the major sublingual duct, opens on the sublingual caruncle alone or after uniting with the submandibular duct. The numerous minor sublingual glands have short ducts that open along the sublingual fold directly into the oral cavity.





5. The tongue, the lingual muscles

The tongue is a mobile muscular organ that can assume a variety of shapes and positions and has a highly differentiated mucous membrane. It is partly in the oral cavity and partly in the oropharynx. The tongue's main functions are articulation (forming words during speaking) and squeezing food into the oropharynx as part of deglutition (swallowing). The tongue is also involved with mastication, taste and oral cleasing.

The tongue can be divided into a body, a tip (apex) and a root which attaches it to the surrounding bony structures. The convex surface of the tongue, the dorsum of the tongue is divided into two portions by a V-shaped furrow known as the terminal sulcus. At the tip of the terminal sulcus is the foramen caecum, from which the thyroid precursor is derived.

About two-thirds of the tongue lie in front of the sulcus. This part forms the oral tongue, also known as the anterior part or presulcal part. Posterior to the sulcus, the remaining one-third forms the pharyngeal part, also known as the posterior part of the tongue. This part lies behind the palatoglossal arch in the oropharynx and is nearly vertical.

→ Anterior part → The mucous membrane covering the dorsum of the tongue is composed of stratified, nonkeratinized squamous epithelium and is firmly attached to the underlying sheet of connective tissue known as the lingual aponeurosis. The mucous membrane covering the oral tongue presents a midline groove known as the median sulcus of tongue. The mucosal structure of the dorsum of the tongue is given its characteristic appearance by the various papillae of tongue which consists of a connective tissue core with an epithelial covering.

Filiform papillae: are thread like papillae which have projections composed of keratinized epithelium that are split at their tips. They are distributed over most of the dorsum of the tongue and mainly transmit tactile information. They do not contain taste buds.

Fungiform papillae: are mushroom-shaped epithelial projections that are mostly located on the margin of the tongue. They contain taste buds as well as mechanoreceptors and thermoreceptors.

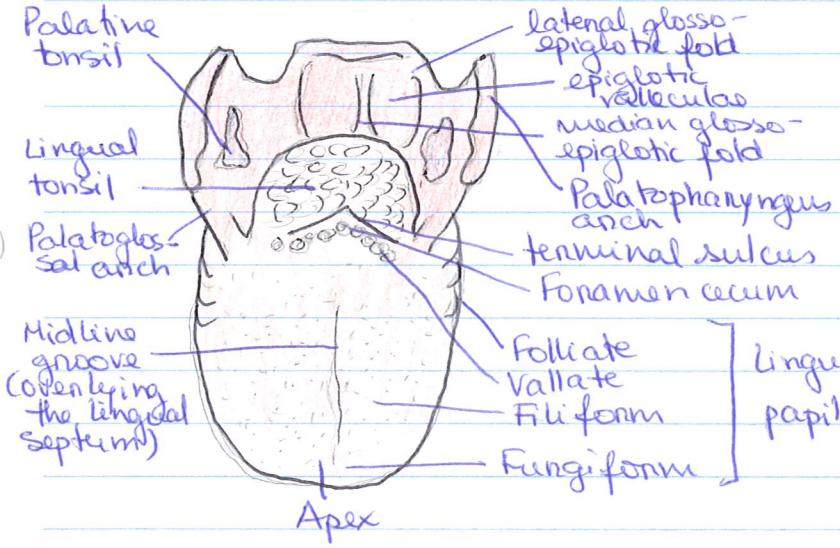
Foliate papillae: are leaf-shaped papillae arranged in rows along the posterior margin of the tongue that have abundant taste buds.

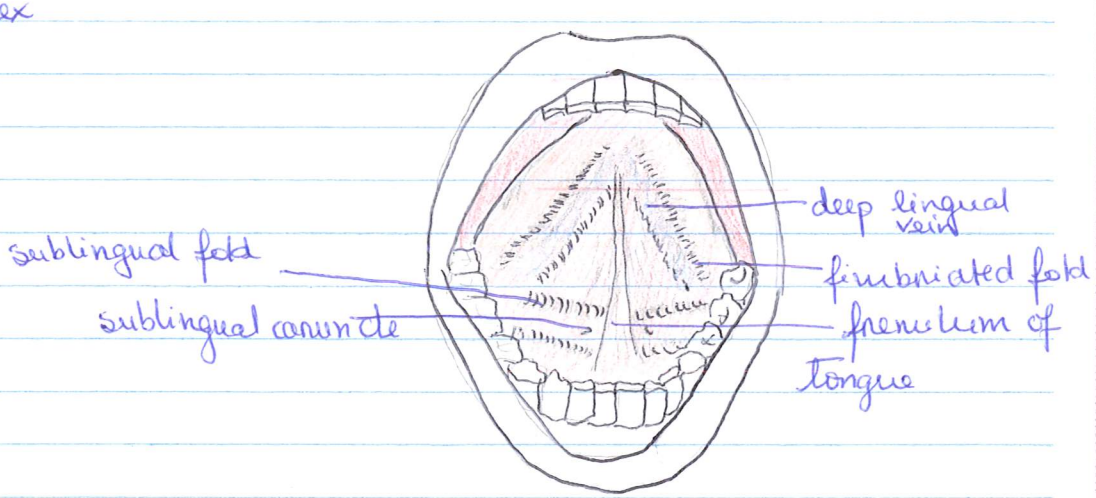
Vallate papillae: the largest type of papilla, lie anterior to the terminal sulcus. They are surrounded by a circular sulcus with a raised wall, and contain numerous taste buds.

→ Posterior part → The mucous membrane of the posterior part of the tongue is thicker and freely movable. It has no lingual papillae, but the underlying lymphoid nodules give this part of the tongue an irregular, cobblestone appearance. The lymphoid nodules are known collectively as the lingual tonsil.

The pharyngeal part of the tongue constitutes the anterior wall of the oropharynx. The base of the tongue is continuous laterally with the palatine tonsil and the lateral wall of the pharynx. Three mucosal folds extend from the posterior part of the tongue to the epiglottis; the median glossoepiglottic fold in the midline and a lateral glossoepiglottic fold from each side. Between these folds are two depressions known as the epiglottic vallecullae.

→ Inferior surface of the tongue: The inferior surface of the tongue is covered with a thin, transparent mucous membrane. This surface is connected to the floor of the mouth by a midline fold called the frenulum of the tongue, a mucosal fold that extends to the gingiva of the mandible. The frenulum allows the anterior part of the tongue to move freely. On each side of the frenulum, a deep lingual vein is visible through the thin mucous membrane. On the floor of the oral cavity the mucosa contains a narrow longitudinal fold on either side known as the sublingual fold which conceals the sublingual gland. A sublingual caruncle (papilla) is present on each side of the base of the lingual frenulum that includes the opening of the submandibular duct from the submandibular salivary gland.





- MUSCLES OF THE TONGUE

Extrinsic muscles of the tongue

MUSCLE	ORIGIN	INSERTION	INNERVATION
genioglossus	Via short tendon from superior part of mental spine of mandible	Entire dorsum of tongue; inferior most and posteriormost fibers attach to body of hyoid bone	hypoglossal nerve (n. XII)

FUNCTION: Bilateral activity depresses tongue, especially central part, creating a longitudinal furrow; posterior part pulls tongue anteriorly for protrusion; most anterior part retracts apex of protruded tongue; unilateral contraction deviates tongue to contralateral side

hyoglossus	Body and greater horn of hyoid bone	Inferior aspects of lateral part of tongue	hypoglossal nerve (n. XII)

FUNCTION: Depresses tongue, especially pulling its sides inferiorly; helps shorten (retrude) tongue

styloglossus	Anterior border of distal styloid process, styloid ligament	Sides of tongue posteriorly, interdigitating with hyoglossus	hypoglossal nerve (n. XII)

FUNCTION: Retrudes tongue and curls its sides, working with genioglossus to form a central trough during swallowing

Palatoglossus	Palatine aponeurosis of soft palate	Enters posterolateral tongue transversely, blending with intrinsic transverse muscles	Pharyngeal branch of vagus nerve (n. X)

FUNCTION: Capable of elevating posterior tongue or depressing soft palate; most commonly acts to constrict isthmus of fauces

Intrinsic muscles of the tongue

MUSCLE	ORIGIN	INSERTION	INNERVATION
superior longitudinal	Submucosal fibrous layer and median fibrous septum	Margins of tongue and mucous membrane	Hypoglossal nerve (n. XII)

FUNCTION: Curls tongue longitudinally upward, elevating apex and sides of tongue; shortens tongue

inferior longitudinal	Root of tongue and body of hyoid bone	Apex of tongue	Hypoglossal nerve (n. XII)

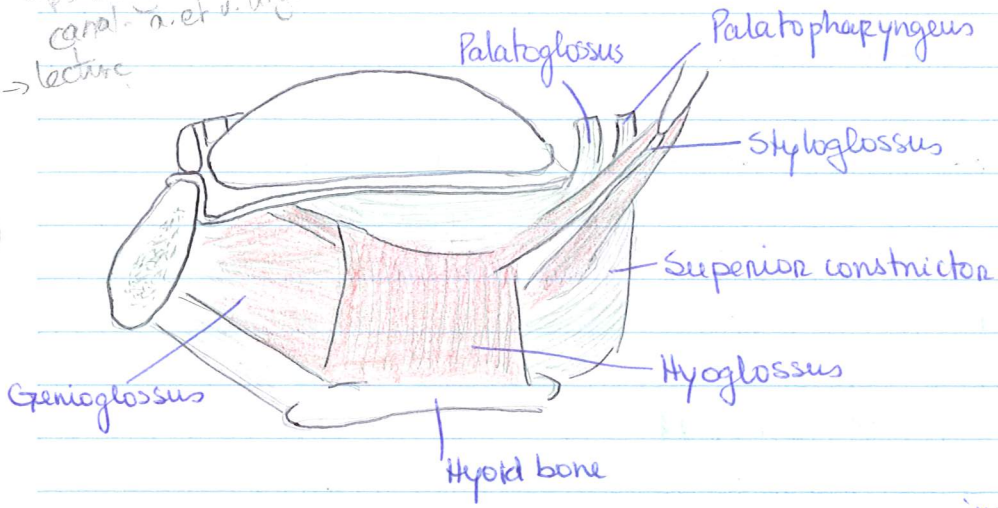
FUNCTION: Curls tongue longitudinally downward, depressing apex; shortens (retrudes) tongue

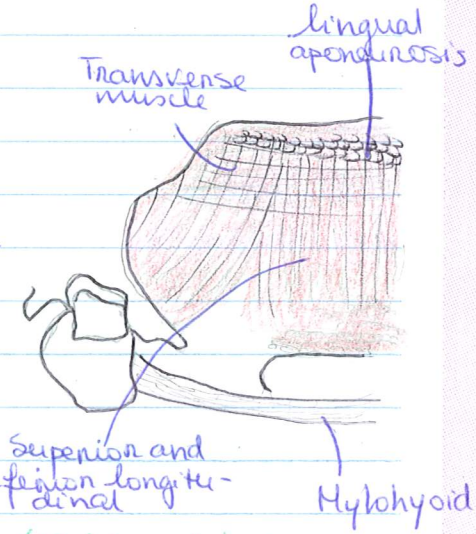
transverse	Median fibrous septum	Fibrous tissue at lateral lingual margins	Hypoglossal nerve (n. XII)

FUNCTION: Narrows and elongates tongue

MUSCLE	ORIGIN	INSERTION	INNERVATION
Vertical	Submucosal fibrous layer of dorsum of tongue	Inferior surface of borders of tongue	Hypoglossal nerve (n. XII)
FUNCTION: Flattens and broadens tongue			

- parapharyngeal canal - a. et v. linguales
→ lecture





6. The palatine tonsils, the isthmus faucium, the tonsillar (Waldeyer's) ring

Palatine tonsils

The palatine tonsils are collections of lymphoid tissue on each side of the oropharynx in the intervalar between the palatine arches. The tonsil does not fill the tonsillar fossa between the palatoglossal and palatopharyngeal arches in adults. The tonsillar bed, in which the palatine tonsil lies, in between these arches. The tonsillar bed is formed by the superior pharyngeal constrictor and the thin, fibrous sheet of pharyngobasilar fascia. This fascia blends with the periosteum of the cranial base and defines the limits of the pharyngeal wall in its superior part.

Isthmus of the fauces

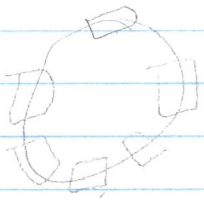
The fauces is the space between the cavity of the mouth and the pharynx. The fauces is bounded superiorly by the soft palate, inferiorly by the root of the tongue, and laterally by the pillars of the fauces, the palatoglossal and palatopharyngeal arches. The isthmus of the fauces is the short constricted space that establishes the connection between the oral cavity proper and the oropharynx.

Waldeyer's ring

Waldeyer's tonsillar ring is an anatomical term describing the lymphoid tissue ring located in the pharynx and to the back of the oral cavity.

The ring consists of (from superior to inferior):

- Pharyngeal tonsil (adenoids)
- Tubal tonsil
- Palatine tonsils
- Lingual tonsils

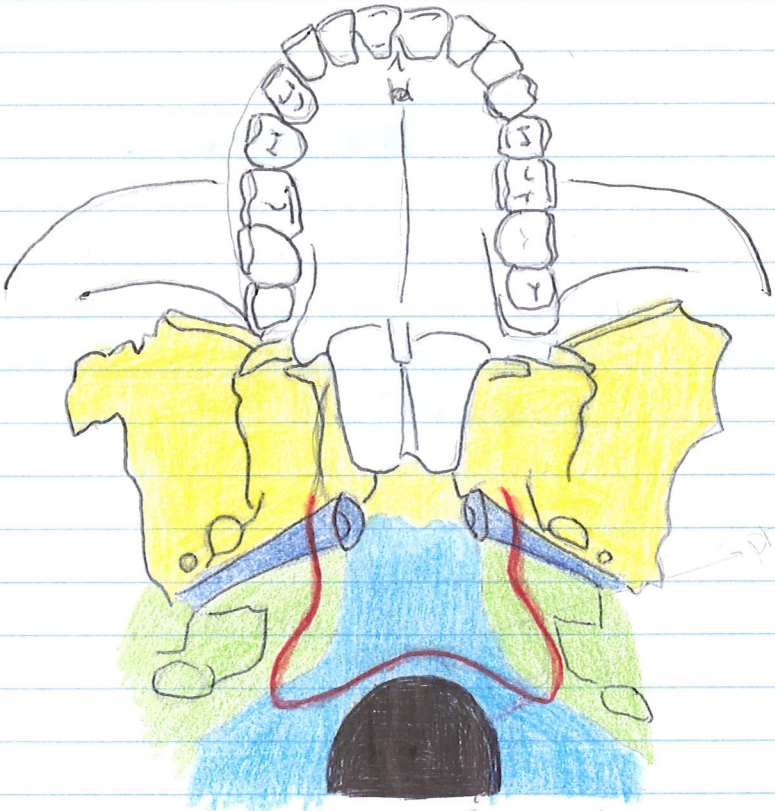


7. The pharynx and the pharyngeal muscles

The pharynx is a 12-15 cm long muscular tube, that extends from its attachment at the base of the cranium to the level of the cricoid cartilage, where it becomes continuous with the esophagus, and the inferior border of the C6 vertebra posteriorly.

The flat posterior wall of the pharynx lies against the prevertebral layer of deep cervical fascia.

There is an irregular C-shaped line of pharyngeal wall attachment on the base of the skull. The open part of the C faces the nasal cavities. Each arm of the C begins at the posterior margin of the medial plate of the pterygoid process of the sphenoid bone, just inferior to the cartilaginous part of the pharyngotympanic tube. The line crosses inferior to the pharyngotympanic tube and then passes onto the petrous part of the temporal bone, where it is just medial to the roughening for the attachment of one of the muscles (levator veli palatini) of the soft palate. From here, the line swings medially onto the occipital bone and joins the line from the other side at a prominent elevation of bone in the midline (the pharyngeal tubercle).



Anterior vertical line of attachment for the lateral pharyngeal walls

- Function

On each side, the anterior line of attachment begins superiorly on the posterior edge of the medial pterygoid plate of the sphenoid bone just inferior to where the pharyngotympanic tube lies. It continues inferiorly along the edge

of the medial plate of the pterygoid process and onto the pterygoid hamulus. From this point, the line descends along the pterygomandibular raphe.

The pterygomandibular raphe is a linear cord-like connective tissue ligament that spans the distance between the tip of the pterygoid hamulus and a triangular roughening immediately posterior to the third molar on the mandible. It joins a muscle of the lateral pharyngeal wall (superior constrictor) with a muscle of the lateral wall of the oral cavity (buccinator).

- Second part

It begins on the lower aspect of the stylohyoid ligament, which connects the tip of the styloid process of the temporal bone to the lesser horn of the hyoid bone. The line continues onto the lesser horn and then turns and runs posteriorly along the entire upper surface of the greater horn of the hyoid where it terminates.

The pharynx can be divided into the following three portions:

- NASOPHARYNX: has a respiratory function, it is the posterior extension of the nasal cavities. The nose opens into the nasopharynx through two choanae (paired openings between the nasal cavity and the nasopharynx). The roof and posterior wall of the nasopharynx form a continuous surface that lies inferior to the body of the sphenoid bone and the basilar part of the occipital bone.

The pharyngeal tonsil (commonly called adenoids) is in the mucous membrane of the roof and posterior wall of the nasopharynx. Extending inferiorly from the medial end of the pharyngotympanic tube (which opens slightly above the level of the hard palate, and lateral to the top of the soft palate) is a vertical fold of mucous membrane, the salpingopharyngeal fold. It covers the salpingopharyngeus muscle, which opens the pharyngeal orifice of the pharyngotympanic tube during swallowing. The collection of lymphoid tissue in the submucosa of the pharynx near the pharyngeal opening or orifice of the pharyngotympanic tube is the tubal tonsil. Because the pharyngotympanic tube projects into the nasopharynx from a posterolateral direction, its posterior rim forms an elevation or bulge on the pharyngeal wall. Posterior to the torus of the pharyngotympanic tube and the salpingopharyngeal fold is a slit-like lateral projection of the pharynx, the pharyngeal recess, which extends laterally and posteriorly.

- OROPHARYNX: has a digestive function. It is bounded by the soft palate superiorly, the base of the tongue inferiorly, and the palatoglossal and palatopharyngeal arches laterally.

Deglutition (swallowing) is the complex process that transfers a food bolus from the

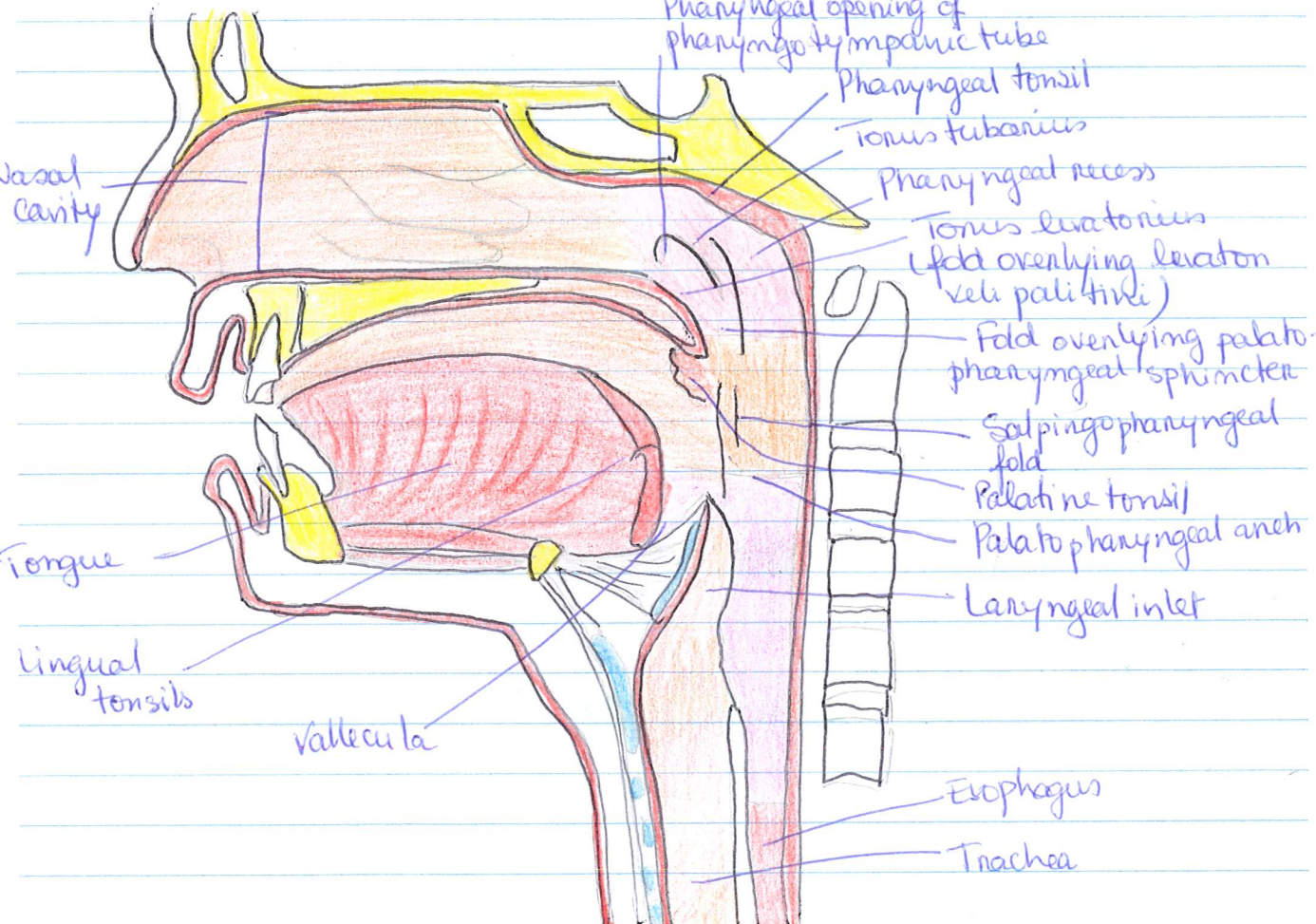
mouth through the pharynx and esophagus into the stomach.

Deglution occurs in three stages:

- Stage 1: voluntary: the bolus is compressed against the palate and pushed from the mouth into the oropharynx, mainly by movements of the muscles of the tongue and soft palate.
- Stage 2: involuntary and rapid; the soft palate is elevated, sealing off the nasopharynx. The pharynx widens and shortens to receive the bolus of food as the suprahyoid muscles and longitudinal pharyngeal muscles contract elevating the larynx.
- Stage 3: involuntary, sequential contraction of all three pharyngeal constrictor muscles forces the food bolus inferiorly into the esophagus

• LARYNGOPHARYNX: lies posterior to the larynx, extending from the superior border of the epiglottis and the pharyngo-epiglottic folds to the inferior border of the cricoid cartilage, where it narrows and becomes continuous with the esophagus. Posteriorly, the laryngopharynx is related to the bodies of C4-C6 vertebrae. Its posterior and lateral walls are formed by the middle and inferior pharyngeal constrictor muscles. Internally, the wall is formed by the palatopharyngeus and stylopharyngeus muscles. The laryngopharynx communicates with the larynx through the laryngeal inlet on its anterior wall.

The piriform fossa (recess) is a small depression of the laryngopharyngeal cavity on either side of the laryngeal inlet. This mucosa-lined fossa is separated from the laryngeal inlet by the ary-epiglottic fold.



Muscles of Pharynx

External layer

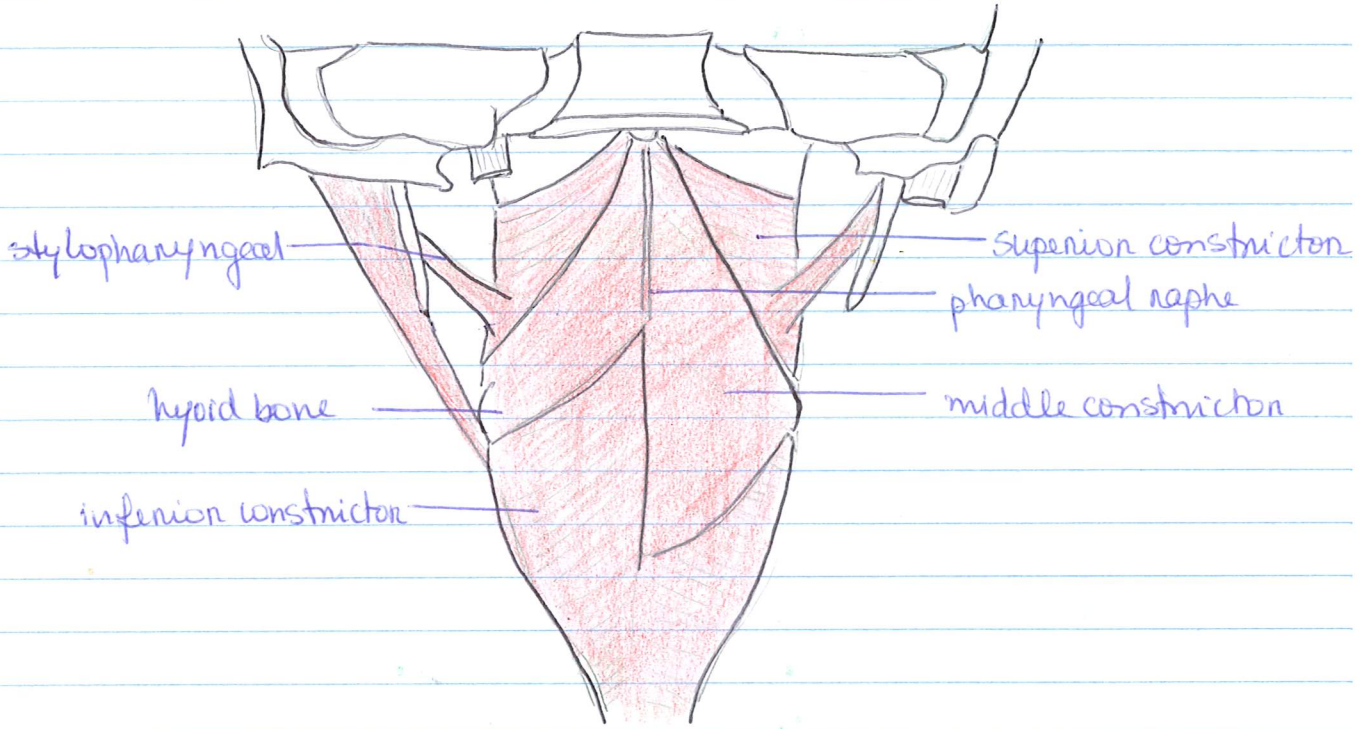
MUSCLE	ORIGIN	INSERTION	INNERVATION
Superior pharyngeal constrictor	Pterygoid hamulus, pterygomandibular raphe, posterior end of mylohyoid line of mandible, and side of tongue	Pharyngeal tubercle on basilar part of occipital bone	Pharyngeal branch of vagus (n. X) and pharyngeal plexus
FUNCTION: constrict walls of pharynx during swallowing			
Middle pharyngeal constrictor	stylohyoid ligament and greater and lesser horns of hyoid	Pharyngeal raphe	Pharyngeal branch of vagus (n. X) and pharyngeal plexus, plus branches of external and recurrent laryngeal nerves of vagus
FUNCTION: constricts walls of pharynx during swallowing			
Inferior pharyngeal constrictor	Oblique line of thyroid cartilage and side of cricoid cartilage	Cricopharyngeal part encircles pharyngoesophageal junction without forming a raphe	Pharyngeal branch of vagus (n. X) and pharyngeal plexus, plus branches of external and recurrent laryngeal nerves of vagus
FUNCTION: constricts walls of pharynx during swallowing			

Internal layer (Levators)

MUSCLE	ORIGIN	INSERTION	INNERVATION
Palantopharyngeus	Hand palate and palatine aponeurosis	Posterior border of lamina of thyroid cartilage and side of pharynx and esophagus	Pharyngeal branch of vagus (n. X) and pharyngeal plexus glossopharyngeus
FUNCTION: elevate (shorten and widen) pharynx and larynx during swallowing and speaking			
Salpingopharyngeus	Cartilaginous part of pharyngotympanic tube	Blends with palatopharyngeus	Pharyngeal branch of vagus (n. X) and pharyngeal plexus
FUNCTION: elevate (shorten and widen) pharynx and larynx during swallowing and speaking			

MUSCLE	ORIGIN	INSERTION	INNERVATION
Stylopharyn-geus (between sup. and middle constrictors)	Styloid process of temporal bone	Posterior and superior borders of thyroid cartilage with palato-pharyngeus	Glossopharyngeal nerve (n. IX)

FUNCTION: elevate (shorten and widen) pharynx and larynx during swallowing and speaking



B. The esophagus and stomach (ventriculus)

The esophagus is a pliable muscular tube that transports the food bolus from the pharynx to the stomach. It is about 25 cm long, beginning at the inferior border of the cricoid cartilage in front of C6/C7 and opening at the level of T10/T11 into the cardial orifice. The esophagus consists of striated (voluntary) muscle in its upper third, and a mixture of striated and smooth muscle in between. The esophagus may be divided into three parts based on the respective regions of the body through wich it passes:

- Cervical part: In first part, it begins immediately posterior to, and at the level of the inferior border of the cricoid cartilage → C6 vertebra.

Externally, the pharyngo-esophageal junction appears as a constriction produced by the cricopharyngeal part of the inferior constrictor muscle (approximately 15 cm from the incisor teeth).

The cervical esophagus inclines slightly to the left as it descends and enters the superior mediastinum via the superior thoracic aperture, where it becomes the thoracic esophagus.

The cervical esophagus lies between the trachea and the cervical vertebral column. It is attached to the trachea by loose connective tissue.

• Thoracic part: The esophagus enters the superior mediastinum between the trachea and vertebral column, where it lies anterior to the bodies of the T1-T4 vertebrae. The esophagus is usually flattened anteroposteriorly. Initially, it inclines to the left but is pushed back to the median plane by the arch of the aorta.

The esophagus descends into the posterior mediastinum from the superior mediastinum, passing posterior to and to the right of the arch of the aorta. It then deviates to the left and passes through the esophageal hiatus in the diaphragm at the level of the T10 vertebra, anterior to the aorta.

The esophagus may have three impressions, or "constrictions" in its thoracic part. The esophagus is compressed by three structures:

(1) lower constrictor of pharynx - 15cm from the incisor teeth
(2) the left main bronchus - 24 cm from the incisor teeth
(3) the diaphragm - 40 cm from the incisor teeth

No constrictions are visible in the empty esophagus; however, as it expands during filling, the structures noted above compress its walls

• Abdominal part: passes through the elliptical esophageal hiatus in the muscular right crus of the diaphragm, just to the left of the median plane at the level of the T10 vertebra. Terminates by entering the stomach at the cardial orifice of the stomach to the left of the midline at the level of the 7th left costal cartilage and T11 vertebra.

Food passes through the esophagus rapidly because of the peristaltic action of its musculature. The esophagus is attached to the margins of the esophageal hiatus in the diaphragm by the phrenicoesophageal ligament, an extension of inferior diaphragmatic fascia. This ligament permits independent movement of the diaphragm and esophagus during respiration and swallowing.

Abdominal part of the esophagus, only 1,25 cm long, passes from the esophageal hiatus in the right crus of the diaphragm to the cardial orifice of the stomach.

The esophagogastric junction lies to the left of the T11 vertebra on the horizontal plane that passes through the tip of the xiphoid process. Immediately superior to this junction, the diaphragmatic musculature forming the esophageal hiatus functions as a physiological inferior esophageal sphincter that contracts and relaxes.

STOMACH

The stomach is a broad, crescent-shaped intraperitoneal hollow organ. It lies in the upper part of the abdomen below the left dome of the diaphragm, partially hidden behind the left costal margin.

It is specialized for the accumulation of ingested food, which it chemically and mechanically prepares for digestion and passage into the duodenum. The gastric juice gradually converts a mass of food into a semiliquid mixture, chyme, which passes fairly quickly into the duodenum. An empty stomach is only of slightly larger caliber than the large intestine

The stomach has four parts:

- Cardia: the part surrounding the cardial orifice, the superior opening or inlet of the stomach - at the level of the T11 vertebra (left side)
- Fundus: the dilated superior part that is related to the left dome of the diaphragm and in an individual standing upright contains air (gastric bubble). The cardial notch is between the esophagus and the fundus.
- Body: the major part of the stomach between the fundus and pylorus antrum.
- Pylorus part: its wider part, the pylorus antrum, leads into the pylorus canal, its narrower part. The pylorus is the distal, sphincteric region of the pylorus part. It is a marked thickening of the circular layer of smooth muscle that controls discharge of the stomach contents through the pylorus orifice into the duodenum. Intermittent emptying of the stomach occurs when intragastric pressure overcomes the resistance of the pylorus.

In the supine position, the pylorus part of the stomach lies at the level of the transpylorus plane, midway between the jugular notch and the pubic crest inferiorly.

The pylorus orifice is approximately 1,25 cm right of the midline.

In terms of its external features, the stomach may be divided into anterior and posterior surfaces. These are separated by the lesser curvature and a greater curvature as well as peritoneal fold attachments. The lesser curvature of the stomach points upward and toward the right. It forms the shorter concave right border of the stomach. The angular incisure, the most inferior part of the curvature, indicates the junction of the body and pylorus part of the stomach. The angular incisure lies just to the left of the midline. The greater curvature of the stomach points downward. It forms the longer convex left border of the stomach. It passes inferiorly to the left from junction of the 5th intercostal space and midclavicular line, then curves to the right, passing deep to the 9th or 10th left cartilage as it continues medially to reach the pylorus antrum.

Arising from the lesser curvature of the stomach is the largest portion of the lesser omentum, the hepatogastric ligament. The greater omentum extends from the greater curvature, forming the gastrocolic ligament which extends between the stomach and transverse colon; the gastrophrenic ligament between the fundus of the stomach and diaphragm; and the gastrosplenic liga-

ment between the greater curvature of the stomach and the spleen.

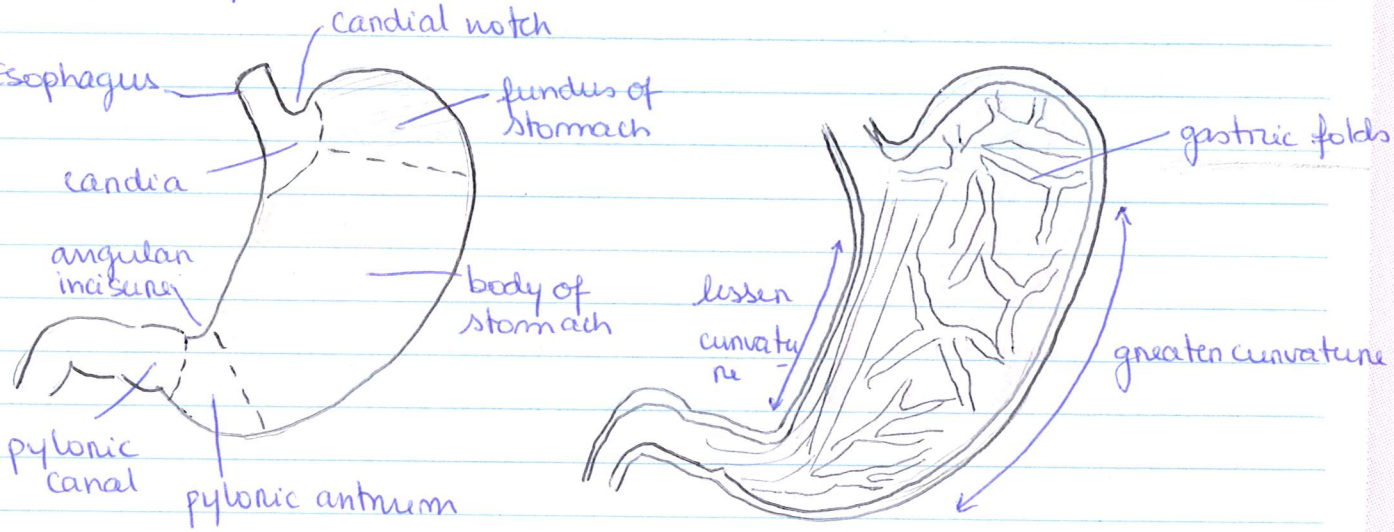
Interior of the stomach

It is covered by a continuous mucous layer that protects its surface from the gastric acid the stomach's glands secrete. When contracted, the gastric mucosa is thrown into longitudinal ridges or wrinkles called gastric folds.

During swallowing, a temporary groove or furrow-like gastric canal forms between the longitudinal gastric folds along the lesser curvature. There is no oblique muscular layer at this site.

Relations of stomach

Anteriorly, the stomach is related to the diaphragm, the left lobe of liver, and the anterior abdominal wall. Posteriorly, the stomach is related to the omental bursa and pancreas; the posterior surface of the stomach forms most of the anterior wall of the omental bursa. The transverse colon is related inferiorly and laterally to the stomach as it courses along the greater curvature of the stomach to the left colic flexure.



10. The duodenum

The duodenum is the first and shortest (25 cm) part of the small intestine. The duodenum pursues a C-shaped course around the head of the pancreas. It begins at the pylorus on the right side and ends at the duodenojejunal flexure (junction) on the left side. This junction occurs approximately at the level of the L2 vertebra, 2-3 cm to the left of the midline. It is considered partially retroperitoneal. The duodenum is divisible into four parts:

- Superior (first) part: short (approximately 5 cm) and lies anterolateral to the body of the L1 vertebra
- Descending (second) part: longer (7-10 cm) and descends along the right sides of the L1-L3 vertebrae.

- Inferior (third) part: 6-8 cm long and crosses the L3 vertebra.
- Ascending (fourth) part: short (5 cm) and begins at the left of the L3 vertebra and rises superiorly as far as the superior border of the L2 vertebra.

The first 2 cm of the superior part of the duodenum, immediately distal to the pylorus, has a mesentery and is mobile. This free part, called the ampulla (duodenal cap), has an appearance distinct from the remainder of the duodenum. The distal 3 cm of the superior part and the other three parts of the duodenum have no mesentery and are immobile because they are retroperitoneal.

The superior part of the duodenum ascends from the pylorus and is overlapped by the liver and gallbladder. The proximal part has the hepatoduodenal ligament (part of the lesser omentum) attached superiorly and the greater omentum attached inferiorly.

The descending part of the duodenum runs inferiorly, curving around the head of the pancreas. Initially, it lies to the right of and parallel to the IVC. The bile and main pancreatic ducts enter its posteromedial wall. These ducts usually unite to form the hepatopancreatic ampulla, which opens on an eminence, called the major duodenal papilla. (Desjardin's pancreatic point — MAL → umbilicus, 6 cm)

The inferior (horizontal) part of the duodenum runs transversely to the left, passing over the IVC, aorta and L3 vertebra.

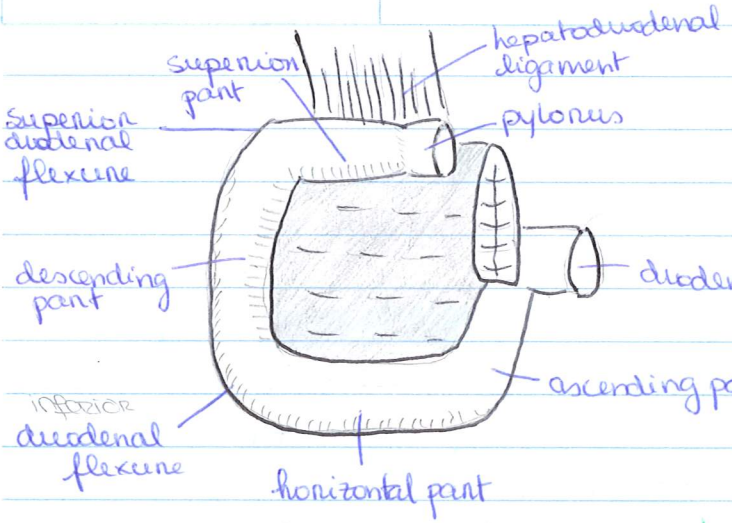
Superior to it is the head of the pancreas and its uncinate process.

Posteriorly it is separated from the vertebral column by the right psoas major, IVC, aorta, and the right testicular or ovarian vessels.

The ascending part of the duodenum runs superiorly and along the left side of the aorta to reach the inferior border of the body of the pancreas. Here it curves anteriorly to join the jejunum at the duodenojejunal flexure, supported by the attachment of a suspensory muscle of the duodenum (ligament of Treitz).

TABLE 2.8. RELATIONSHIPS OF DUODENUM

Part of Duodenum	Anterior	Posterior	Medial	Superior	Inferior	Vertebral Level
Superior (1st part) **(A & B)**	Peritoneum Gallbladder Quadrate lobe of liver	Bile duct Gastroduodenal artery Hepatic portal vein IVC	Pylorus	Neck of gallbladder	Neck of pancreas	Anterolateral to L1 vertebra
Descending (2nd part) **(C)**	Transverse colon Transverse mesocolon Coils of small intestine	Hilum of right kidney Renal vessels Ureter Psoas major	Head of pancreas Pancreatic duct Bile duct	Superior part of duodenum	Inferior part of duodenum	Right of L2–L3 vertebrae
Inferior (horizontal) (3rd part) **(D)**	SMA SMV Coils of small intestine	Right psoas major IVC Aorta Right ureter		Head and uncinate Process of pancreas Superior mesenteric vessels	Coils of small intestine (ilium)	Anterior to L3 vertebra
Ascending (4th part) **(E)**	Beginning of root of mesentery Coils of jejunum	Left psoas major Left margin of aorta	SMA, SMV, uncinate process of pancreas	Body of pancreas	Coils of jejunum	Left of L3 vertebra



1. The small intestine (intestinum tenue), jejunum, ileum

Below the stomach, the alimentary canal is continuous with the small intestine. Its segments consist of the duodenum, jejunum and ileum which opens in the right iliac fossa into the large intestine. The average length of the entire small intestine is about 7 m. It is the primary site for absorption of nutrients from ingested materials. It extends from the pylorus to the ileocecal junction.

The second part of the small intestine, the jejunum, begins at the duodenojejunal flexure where the digestive tract resumes an intraperitoneal course. The third part of the small intestine, the ileum, ends at the cecum. Together, the jejunum and ileum are 6-7 m long, the jejunum constituting approximately 2/5 and the ileum approximately 3/5 of the intraperitoneal section of the small intestine.

Most of the jejunum lies in the left upper quadrant of the infracolic compartment, whereas most of the ileum lies in the right lower quadrant.

Although no clear line of demarcation between the jejunum and ileum exists, they have distinctive characteristics.

The mesentery is a fan-shaped fold of peritoneum that attaches the jejunum and ileum to the posterior abdominal wall. The origin or root of the mesentery (approximately 15 cm long) is directed obliquely, inferiorly, and to the right. It extends from the duodenojejunal junction on the left side of the vertebra L2 to the ileocolic junction and the right sacroiliac joint. The average length of the mesentery from its root to the intestinal border is 20 cm.

Between the two layers of the mesentery are the superior mesenteric vessels, lymph nodes, a variable amount of fat, and autonomic nerves.

CHARACTERISTIC	JEJUNUM	ILEUM
location	upper left part of inframesocolic space	lower right part of the inframesocolic space
Diameter	wider (3-4 cm)	narrower (2-3 cm)
n° plicae	more plicae circulares	fewer plicae circulares
n° arcades	1-2 arcades	2-3 arcades
lymphatic tissue	follicoli lymphatici solitarii	follicoli lymphatici aggregati (Peyer's patches)

11. The large intestine (colon)

The large intestine is where water is absorbed from the indigestible residues of the liquid chyme, converting it into semisolid stool or feces that is stored temporarily and allowed to accumulate until defecation occurs. The large intestine consists of the cecum; appendix; ascending, transverse, descending, and sigmoid colon, rectum; and anal canal. The large intestine can be distinguished from the small intestine by:

- Omental appendices: small, fatty, omentum-like projections.
- Teniae coli: three distinct longitudinal bands: (1) mesocolic tenia, to which the transverse and sigmoid mesocolons attach; (2) omental tenia, to which the omental appendices attach; and (3) free tenia, to which neither mesocolons nor omental appendices are attached.
- Haustra: sacculations of the wall of the colon between the teniae
- A much greater calibre (internal diameter).

The teniae coli (thickened bands of smooth muscle representing most of the longitudinal coat) begin at the base of the appendix as the thick longitudinal layer of the appendix separates into three bands. The teniae run the length of the large intestine, abruptly broadening and merging with each other again at the rectosigmoid junction into a continuous longitudinal layer around the rectum. Because their tonic contraction shortens the part of the wall with which they are associated, the colon becomes sacculated or "baggy" between the teniae, forming the haustra. Projecting into the intestinal lumen are the semilunar folds of colon.

The colon has four parts - ascending, transverse, descending and sigmoid - that succeed one another in an arch. The colon encircles the small intestine, the ascending colon lying to the right of the small intestine, the transverse colon superior and/or anterior to it, the descending colon to the left if it, and the sigmoid colon inferior to it.

The ascending colon is the second part of the large intestine. It passes superiorly on the right side of the abdominal cavity from the cecum to the right lobe of the liver, where it turns to the left at the right colic flexure (hepatic flexure). This flexure lies deep to the 9th and 10th ribs and is overlapped by the inferior part of the liver. It is secondarily retroperitoneal along the right side of the posterior abdominal wall. The ascending colon is usually covered by peritoneum anteriorly and on its sides. The ascending colon is separated from the anterolateral abdominal wall by the greater omentum.

The transverse colon is the third, longest, and most mobile part of the large intestine. It crosses the abdomen from the right colic flexure to the left colic flexure, where it turns inferiorly to become the descending colon. The left colic flexure (splenic flexure) is usually more superior, more acute, and less mobile than the

right colic flexure. It lies anterior to the inferior part of the left kidney and attaches to the diaphragm through the phrenicocolic ligament. The transverse colon and its mesentery, the transverse mesocolon, loops down, often inferior to the level of the iliac crests.

The root of the transverse mesocolon lies along the inferior border of the pancreas and is continuous with the parietal peritoneum posteriorly.

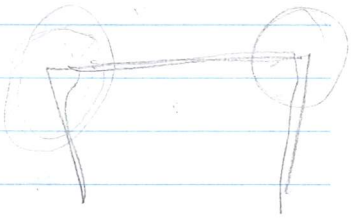
The descending colon occupies a secondarily retroperitoneal position between the left colic flexure and the left iliac fossa, where it is continuous with the sigmoid colon.

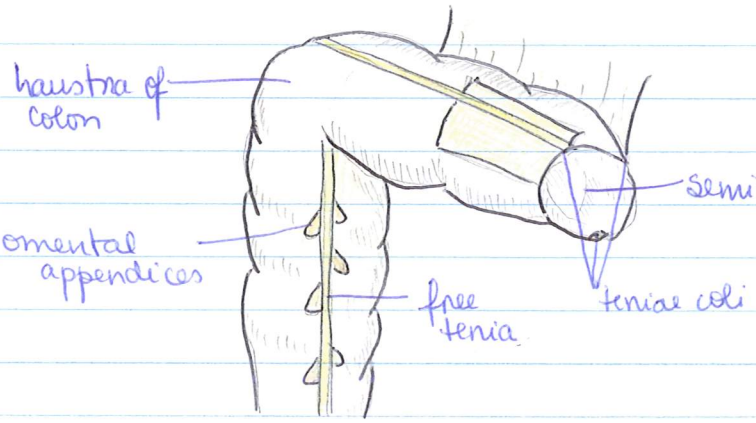
As it descends, the colon passes anterior to the lateral border of the left kidney.

The sigmoid colon, characterized by its S-shaped loop of variable length, links the descending colon and the rectum. The sigmoid colon extends from the iliac fossa to the third sacral (S3) vertebra, where it joins the rectum. The termination of the teniae coli, approximately 15 cm from the anus, indicates the rectosigmoid junction.

The sigmoid colon usually has a long mesentery - the sigmoid mesocolon - and therefore has considerable freedom of movement, especially its middle part.

The root of the sigmoid mesocolon has an inverted V-shaped attachment, extending first medially and superiorly along the external iliac vessels and then medially and inferiorly from the bifurcation of the common iliac vessels to the anterior aspect of the sacrum. The left ureter and the division of the left common iliac artery lie retroperitoneally, posterior to the apex of the root of the sigmoid mesocolon. The omental appendices of the sigmoid colon are long; they disappear when the sigmoid mesentery terminates. The teniae coli also disappear as the longitudinal muscle in the wall of the colon broadens to form a complete layer in the rectum.





12. The cecum, the appendix and its positions

The cecum is the first part of the large intestine; it is continuous with ascending colon. The cecum is a blind intestinal pouch, approximately 7,5 cm. It lies in the iliac fossa of the right lower quadrant of the abdomen, inferior to the junction of the

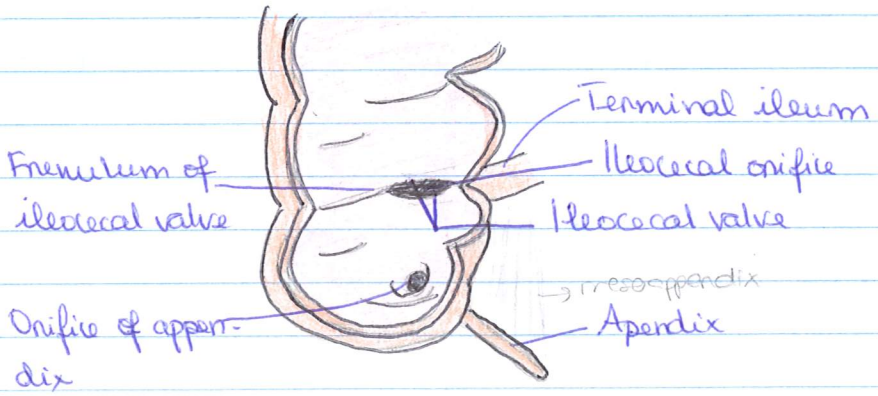
Terminal ileum and cecum.

The cecum usually lies within 2,5 cm of the inguinal ligament. The cecum has no mesentery. The terminal ileum enters the cecum obliquely and partly invaginates into it. The ileal orifice enters the cecum between ileocolic lips (superion and inferion), folds that meet laterally forming ridges called the frenula of the ileal orifice. The orifice is usually closed by tonic contraction, however, appearing as an ileal papilla on the cecal side.

The appendix (traditionally, vermiform appendix) is a blind intestinal diverticulum that contains masses of lymphoid tissue. It arises from the posteromedial aspect of the cecum inferion to the ileocecal junction. The appendix has a short triangular mesentery, the mesoappendix. The mesoappendix attaches to the cecum and the proximal part of the appendix. The position of the appendix is variable, but it is usually retrocecal.

A retrocecal appendix (65%) extends superiorly toward the right colic flexure. The appendix may project inferiorly toward on across the pelvic brim (31%) on be positioned in front of the ileum - preileal (1%) on behind it - retroileal (0,5%).

The base of the appendix lies deep to a point that is one third of the way along the oblique line joining the right ASIS to the umbilicus (the McBurney point on the spinoumbilical line).



13. The rectum

The rectum is the pelvic part of the digestive tract and is continuous proximally with the sigmoid colon and distally with the anal canal. The rectosigmoid junction lies anterion to the S3 vertebra. At this point, the teniae of the sigmoid colon spread to form a continuous outer longitudinal layer of smooth muscle, and the fatty omental appendices are discontinued.

The human rectum is characterized by a number of flexures. The rectum follows the curve of the sacrum and coccyx, forming the sacral flexure of the rectum. The rectum ends anteroinferion to the tip of the coccyx, immediately before a sharp posteroinferion angle (the anorectal flexure of the anal canal) that occurs as the gut perforates the pelvic diaphragm (levator ani).

With the flexures of the rectosigmoid junction superiorly and the anorectal

junction inferiorly, the rectum has an S shape when viewed laterally.

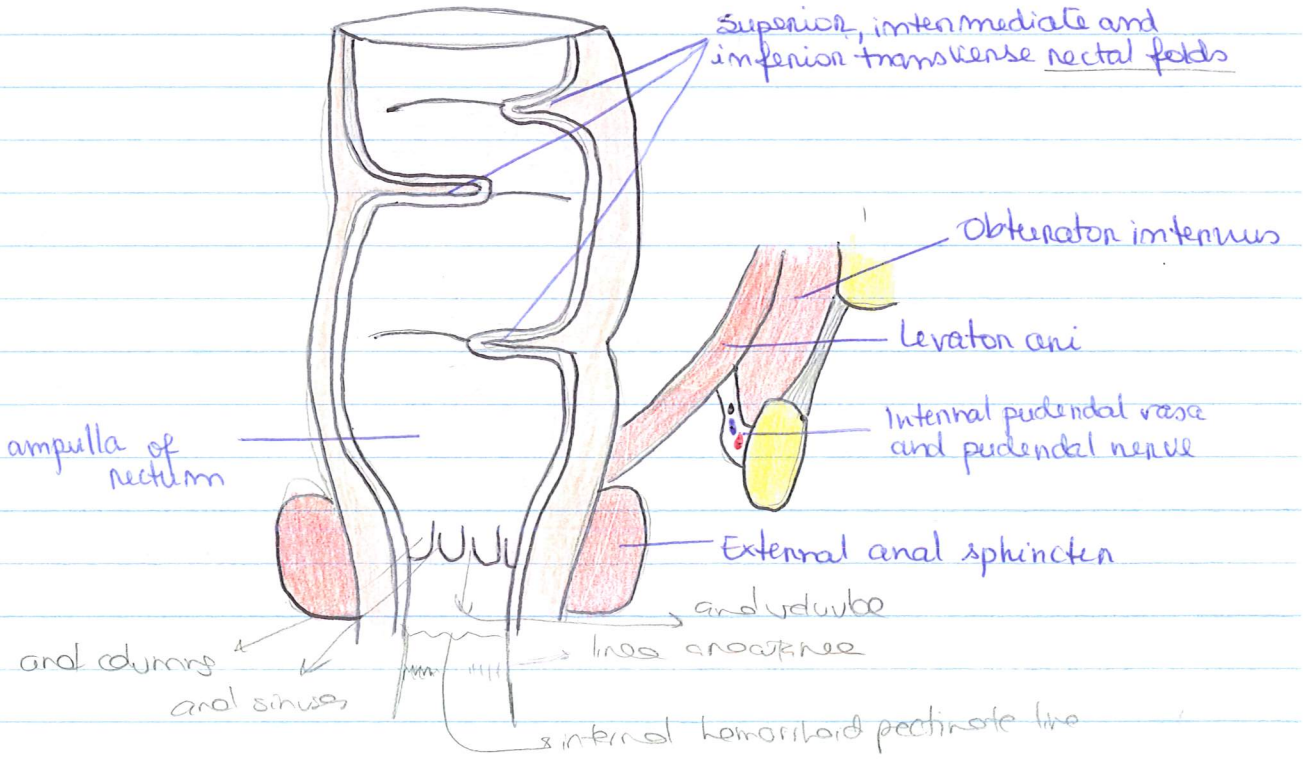
Three sharp flexures of the rectum (superior and inferior on the left side, and intermediate on the right) are apparent when the rectum is viewed anteriorly. The flexures are formed in relation to three internal infoldings (transverse rectal folds): two on the left and one on the right side (Kohlrausch's fold).

The dilated terminal part of the rectum, lying directly superior to and supported by the pelvic diaphragm (levator ani) and anococcygeal ligament, is the ampulla of the rectum.

Peritoneum covers the anterior and lateral surfaces of the superior third of the rectum. In males, the peritoneum reflects from the rectum to the posterior wall of the bladder, where it forms the floor of the rectovesical pouch. In females, the peritoneum reflects from the rectum to the posterior part of the fornix of the vagina, where it forms the floor of the rectouterine pouch. In both sexes, lateral reflections of peritoneum from the superior third of the rectum form pararectal fossae.

The anal canal, about 4 cm long, is the final portion of the intestinal canal. It is surrounded by a complex sphincter apparatus and opens at the anus.

Surrounding the anal canal is a complex sphincter apparatus. Its components consist of an inner layer of the smooth muscle forming the internal anal sphincter and an outer layer of striated muscle forming the external anal sphincter, the fibers of which pass caudal to the pelvic musculature to blend with the levator ani muscle.



14. The pancreas and spleen

PANCREAS

The pancreas is an accessory digestive gland that lies retroperitoneally, overlying and transversely crossing the bodies of the L1 and L2 vertebra (the level of the transpyloric plane) on the posterior abdominal wall. It lies posterior to the stomach between the duodenum on the right and the splein on the left.

The pancreas produces:

- an exocrine secretion (pancreatic juice from the acinar cells) that enters the duodenum through the main and accessory pancreatic ducts.
- endocrine secretions (glucagon and insulin from the pancreatic islets of Langerhans) that enter the blood

For descriptive purposes, the pancreas is divided into four parts: head, neck, body and tail.

The head of the pancreas is the expanded part of the gland that is embraced by the C-shaped curve of the duodenum to the right of the superior mesenteric vessel just inferior to the transpilonic plane.

The uncinate process, a projection from the inferior part of the pancreatic head, extends medially to the left, posterior to the SMA. The pancreatic head rests posteriorly on the IVC, right renal artery and vein, and left renal vein. The bile duct lies in a groove on the posteriosuperior surface of the head.

The neck of the pancreas is short (1,5 - 2 cm) and overlies the superior mesenteric vessels, which form a groove in its posterior aspect.

The SMV joins the splenic vein posterior to the neck to form the hepatic portal vein.

The body of the pancreas continues from the neck and lies to the left of the superior mesenteric vessels, passing over the aorta and L2 vertebra, continuing just above the transpyloric plane posterior to the omental bursa. The anterior surface of the body of the pancreas is covered with peritoneum and lies in the floor of the omental bursa and forms part of the stomach bed. The posterior surface of the body is devoid of peritoneum and is in contact with the aorta, SMA, left suprarenal gland, left kidney, and renal vessels.

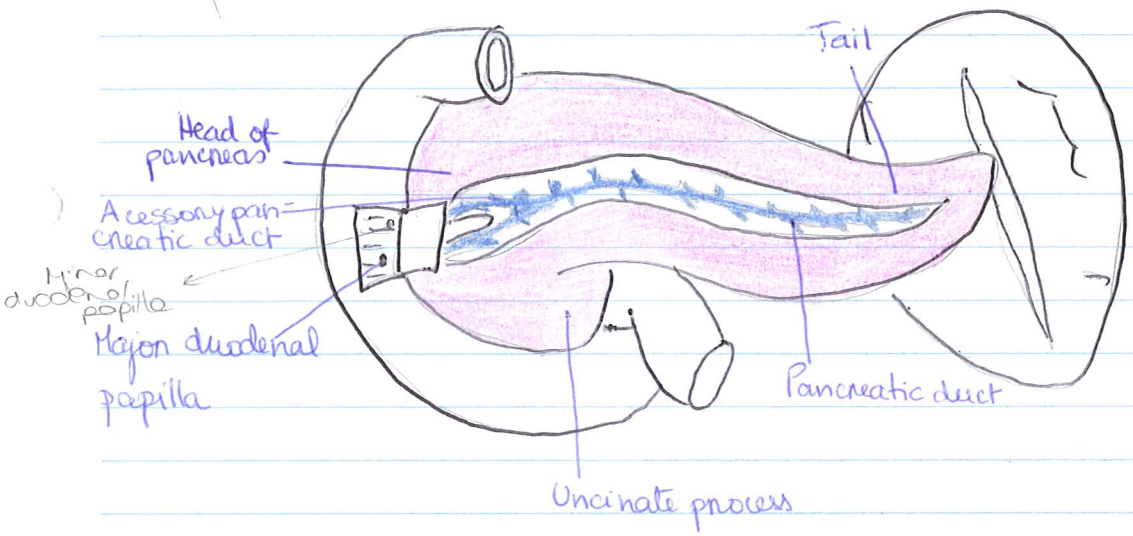
The tail of the pancreas lies anterior to the left kidney, where it is closely related to the splenic hilum and the left colic flexure.

The main pancreatic duct begins in the tail of the pancreas and runs through the parenchyma of the gland to the pancreatic head: here it turnons inferiorly and is closely related to the bile duct. ~~The main pancreatic duct and bile duct.~~ The main pancreatic duct and bile duct usually unite to form the short, dilated hepatopancreatic ampulla (of Vater), wich opens into the descending part of the duodenum at the summit of the major duodenal papilla.

The sphincter of the pancreatic duct (around the terminal part of the pancreatic

duct), the sphincter of the bile duct (around the termination of the bile duct), and the hepatopancreatic sphincter (of Oddi) - around the hepatopancreatic ampulla - are smooth muscle sphincters that control the flow of bile and pancreatic juice into the ampulla and prevent reflux of duodenal content into the ampulla.

The accessory pancreatic duct opens into the duodenum at the summit of the minor duodenal papilla.



SPLEEN

It is relatively delicate and considered the most vulnerable abdominal organ. The spleen is located in the superolateral part of the left upper quadrant or hypochondrium of the abdomen where it enjoys protection of the inferior thoracic cage.

As the largest of the lymphatic organs, it participates in the body's defense system as a site of lymphocyte (white blood cell) proliferation and of immune surveillance and response.

To accomodate these functions, the spleen is soft, vascular (sinusoidal) mass with a relatively delicate fibroelastic capsule. The thin capsule is covered with a layer of visceral peritoneum that entirely surrounds the spleen except at the splenic hilum, where the splenic branches of the splenic artery and vein enter and leave. It does not descend inferior to the costal (rib) region it rests on the left colic flexure. It is associated posteriorly with the left 9th - 11th ribs and separated from them by the diaphragm and the costodiaphragmatic recess

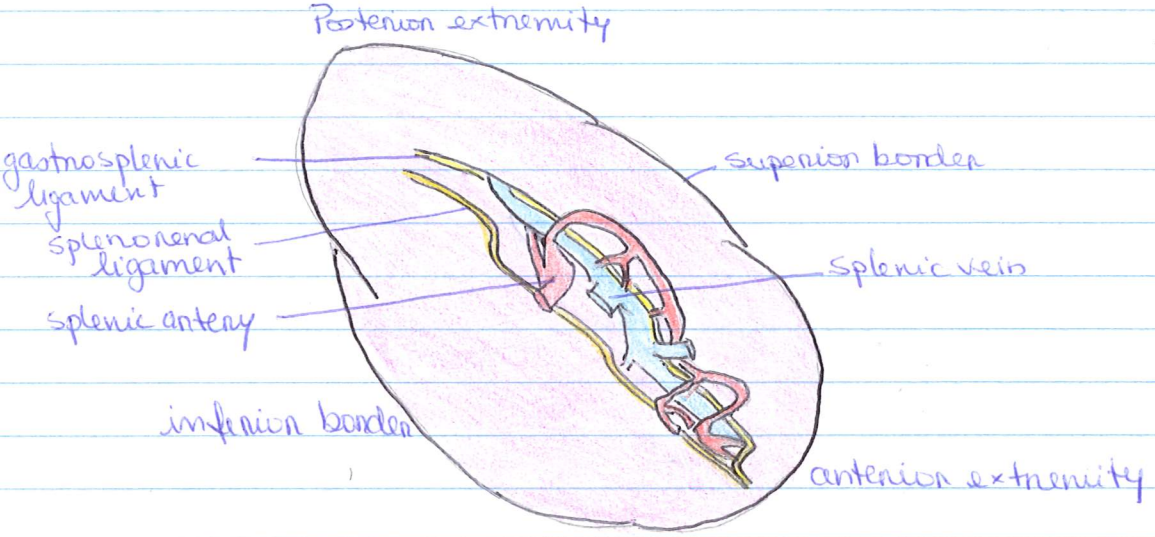
The relations of the spleen are:

- Anteriorly, the stomach
- Posteriorly, the left part of the diaphragm, wich separates it from the pleura, lung and ribs 9-11
- Inferiorly, the left colic flexure
- Medially, the left Kidney

It is usually approximately 12 cm long and 7 cm wide.

The anterior and superior borders of the spleen are sharp and often notched, whereas its posterior (medial) end and inferior border are rounded

The spleen contacts the posterior wall of the stomach and is connected to its greater curvature by the gastrosplenic ligament, and to the left kidney by the splenorenal ligament. These ligaments, containing splenic vessels, are attached to the hilum. It constitutes the left boundary of the omental bursa.



15. The liver (hepar)

The liver is the largest gland in the body and it weights approximately 1500 g.

Except for fat, all nutrients absorbed from the digestive tract are initially conveyed to the liver by the portal venous system. In addition to its many metabolic activities, the liver stores glycogen and secretes bile.

The liver lies mainly in the right upper quadrant of the abdomen where it is protected by the thoracic cage and diaphragm. The normal liver lies deep to ribs 7-11 on the right side and crosses the midline toward the left nipple. Consequently, the liver occupies most of the right hypochondrium and upper epigastrium and extends into the left hypochondrium.

The liver has a convex diaphragmatic surface (anterior, superior and some posterior) and a relatively flat or even concave visceral surface (postero-inferior), which are separated anteriorly by its sharp inferior border that follows the right costal margin, inferior to the diaphragm.

The diaphragmatic surface of the liver is smooth and dome shaped, where it is related to the concavity of the inferior surface of the diaphragm, which separates it from the pleurae, lungs, pericardium, and heart. Subphrenic recesses - superior extensions of the peritoneal cavity (greater sac) - exist between diaphragm and the anterior and superior aspects of the diaphragmatic surface of the liver. The subphrenic recesses are separated into right and left recesses by the falciform ligament, which extends between the liver and the anterior abdominal wall.

The diaphragmatic surface of the liver is covered with visceral peritoneum, except posteriorly in the bare area of the liver, where it lies in direct contact with the diaphragm. Anterior (upper) and posterior (lower) layers of the coronary ligament meet on the right to form the right triangular ligament and diverge toward the left to enclose the triangular bare area. The anterior layer of the coronary ligament is continuous on the left with the right layer of the falciform ligament, and the posterior layer is continuous with the right layer of the lesser omentum. Near the apex the anterior and posterior layers of the left part of the coronary ligament meet to form the left triangular ligament. The IVC transverses a deep groove for the vena cava within the bare area of the liver.

The visceral surface of the liver is covered with peritoneum except at the fossa for the gallbladder and the porta hepatis - a transverse fissure where the vessels (hepatic portal vein, hepatic artery, and lymphatic vessels) and hepatic ducts that supply and drain the liver enter and leave it. In contrast to the smooth diaphragmatic surface, the visceral surface bear multiple fissures and impressions from contact with other organs.

Two sagittally oriented fissures, linked centrally by the transverse porta hepatis, form the letter H on the visceral surface. The right sagittal fissure is the continuous groove formed anteriorly by the fossa for the gallbladder and posteriorly by the groove for the vena cava. The umbilical (left sagittal) fissure is the continuous groove formed anteriorly by the fissure for the round ligament and posteriorly by the fissure for the ligamentum venosum. The round ligament of the liver is the fibrous remnant of the umbilical vein. The ligamentum venosum is the fibrous remnant of the fetal ductus.

The lesser omentum, enclosing the portal triad passes from the liver to the lesser curvature of the stomach and the first 2 cm of the superior part of the duodenum - the hepatoduodenal ligament. The sheet-like remainder of the lesser omentum, the hepatogastric ligament, extends between the groove for the ligamentum venosum and the lesser curvature of the stomach.

The visceral surface reflect the liver's relationship to the:

- Right side of the anterior aspect of the stomach
- Superior part of the duodenum
- Lesser omentum
- Gallbladder
- Right colic flexure and right transverse colon
- Right kidney and suprarenal gland

Anatomical lobes of the liver

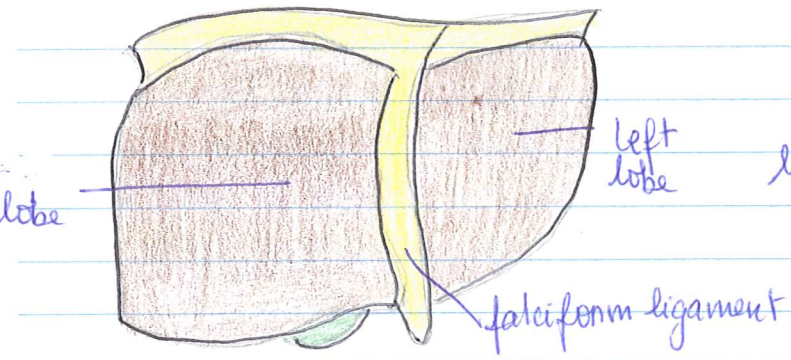
The essentially midline plane defined by the attachment of the falciform ligament and the left sagittal fissure separates a large right lobe from a much smaller left lobe. On the slanted visceral surface, the right and left sagittal fissures course on each side of - and the transverse portahepatis separates - two accessory lobes: the quadrate lobe anteriorly and inferiorly and the caudate lobe posteriorly and superiorly

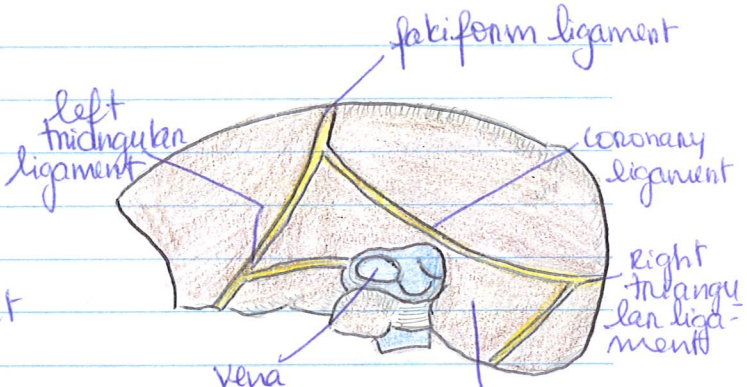
Functional subdivision of liver

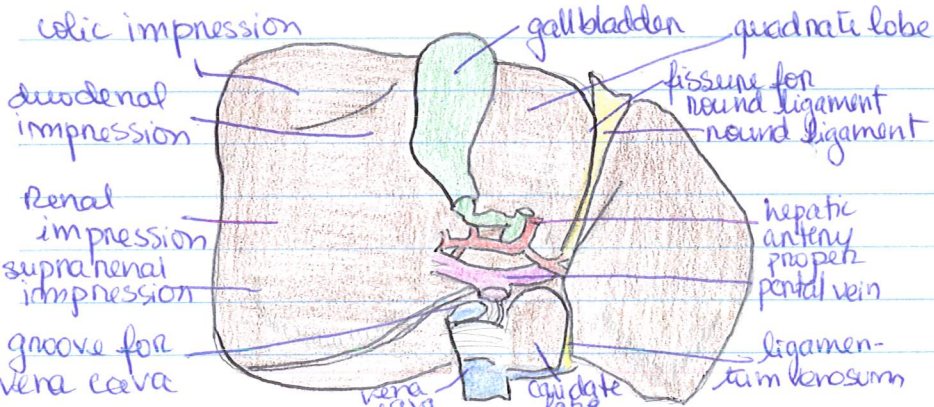
Each part receives its own primary branch of the hepatic artery and hepatic portal vein and is drained by its own hepatic duct.

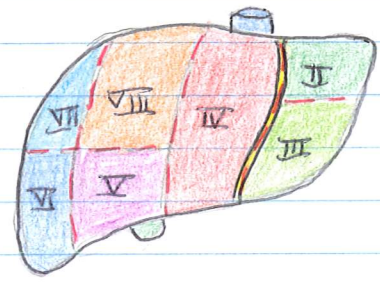
The liver can be further subdivided into four divisions and them into eight surgically resectable hepatic segments, each served independently by a secondary or tertiary branch of the portal triad, respectively.

The plane is demarcated on the diaphragmatic surface by extrapolating an imaginary line - the Cantlie line - from the notch for the fundus of the gallbladder to the IVC. The right and left livers are subdivided vertically into medial and lateral divisions by the right portal and umbilical fissures, in which the right and left hepatic veins lie. The right portal fissure has no external demarcation. Each of the four divisions receives a secondary (2°) branch of the portal triad. A transverse hepatic plane at the level of the horizontal parts of the right and left branches of the portal triad subdivides three of the four divisions (all but the left medial division), creating six hepatic segments, each receiving tertiary branches of the triad. The main part of the liver has seven segments (segments II - VIII, numbered clockwise). The caudate lobe, segment I, brings the total number of segments to 8.









16. The gallbladder (vesica felea); the biliary ducts

The biliary ducts convey bile from the liver to the duodenum

The hepatocytes secrete bile into the bile canaliculi formed between them. The canaliculi drain into the small interlobular biliary ducts and then into large collecting bile ducts of the intrahepatic portal triad, which merges to form the hepatic ducts. The right and left hepatic ducts drain the right and left (part of the) liver, respectively. Shortly after leaving the porta hepatis, these hepatic ducts unite to form the common hepatic duct, which is joined on the right side by the cystic duct to form the bile duct.

The bile duct forms by the union of the cystic duct and common hepatic duct. The length of the bile duct varies from 5 to 15 cm depending on where the cystic duct joins the common hepatic duct.

The bile duct descends posterior to the superior part of the duodenum and lies in a groove on the posterior surface of the head of the pancreas. On the left side of the descending part of the duodenum, the bile duct comes into contact with the main pancreatic duct. They unite, forming a dilatation, the hepatopancreatic ampulla. The distal end of the ampulla opens into the duodenum through the major duodenal papilla. The circular muscle around the distal end of the bile duct is thickened to form the sphincter of the bile duct. When this sphincter contracts, bile cannot enter the ampulla and the duodenum; hence bile backs up and passes along the cystic duct to the gallbladder for concentration and storage.

GALL BLADDER

The gallbladder (7-10 cm long) lies in the fossa for the gallbladder on the visceral surface of the liver.

The body of the gallbladder lies anterior to the superior part of the duodenum, and its neck and cystic duct are immediately superior to the duodenum

The pear-shaped gallbladder can hold up to 50 ml of bile.

The gallbladder has 3 parts:

- Fundus: usually projects from the inferior border of the liver
- Body: main portion that contacts the visceral surface of the liver, transverse colon, and superior part of the duodenum
- Neck: makes an S-shaped bend and joins the cystic duct

The cystic duct connects the neck of the gallbladder to the common hepatic duct. The mucosa of the neck spirals into the spiral fold. The spiral fold helps keep the cystic duct open; thus bile can easily be diverted into the gallbladder when the distal end of the bile duct is closed by the sphincter of the bile duct and/or hepatopancreatic sphincter.

The cystic duct passes between the layers of the lesser omentum.

17. The peritoneum and its folds

The peritoneum is a transparent serous membrane. It lines the abdomino-pelvic cavity and invests the viscera. The peritoneum consists of two continuous layers: the parietal peritoneum, which lines the internal surface of the abdomino-pelvic wall, and the visceral peritoneum, which invests viscera such as the stomach and intestines. Both layers of peritoneum consist of mesothelium, a layer of simple squamous epithelial cells.

The relationship of the viscera to the peritoneum is as follows:

- Intraperitoneal organs are almost completely covered with visceral peritoneum. Intraperitoneal organs have conceptually, if not literally, invaginated into the closed sac, like pressing your fist into an inflated balloon.
- Extraperitoneal, retroperitoneal and subperitoneal organs are only partially covered with peritoneum (usually on just one surface). Retroperitoneal organs such as the kidneys are between the parietal peritoneum and the posterior abdominal wall and have parietal peritoneum only on their anterior surfaces.

The peritoneal cavity is within the abdominal cavity and continues inferiorly into the pelvic cavity. The peritoneal cavity is a potential space of capillary thinness between the parietal and visceral layers of peritoneum and contains a thin film of peritoneal fluid.

Peritoneal fluid lubricates the peritoneal surfaces, enabling the viscera to move over each other without friction, and allowing the movements of digestion.

The peritoneal cavity is completely closed in males. However, there is a communication pathway in females to the exterior of the body through the uterine tubes, uterine cavity, and vagina. This communication constitutes a potential pathway of infection from the exterior.

Peritoneal formations

A mesentery is a double layer of peritoneum that occurs as a result of the invagination of the peritoneum by an organ and constitutes a continuity of the visceral and parietal peritoneum. It provides a means for neurovascular communications between the organ and the body wall.

The small intestine mesentery is usually referred to simply as "the mesentery"

An omentum is a prominent, four-layered peritoneal fold that hangs down like an apron from the greater curvature of the stomach and the proximal part of the duodenum to adjacent organs in the abdominal cavity.

- The greater omentum is a prominent, four-layered peritoneal fold that hangs down like an apron from the greater curvature of the stomach and the proximal part of the duodenum. After descending, it folds back and attaches to the anterior surface of the transverse colon and its mesentery.

- The lesser omentum is a much smaller, double-layered peritoneal fold that connects the lesser curvature of the stomach and the proximal part of the duodenum to the liver. It also connects the stomach to a triad of structures that run between the duodenum and liver in the free edge of the lesser omentum.

A peritoneal ligament consists of a double layer of peritoneum that connects an organ with another organ or to the abdominal wall

The liver is connected to the:

- Anterior abdominal wall by the falciform ligament
- Stomach by the hepatogastric ligament } lesser omentum
- Duodenum by the hepatoduodenal ligament

The stomach is connected to the

- Inferior surface of the diaphragm by the gastrophrenic ligament
- Spleen by the gastrosplenic ligament, which reflects to the hilum of the spleen.
- Transverse colon by the gastrocolic ligament, the apron-like part of the greater omentum.

These are all part of the greater omentum.

A peritoneal fold is a reflection of peritoneum that is raised from the body wall by underlying blood vessels, ducts, etc.

Some peritoneal folds contain blood vessels and bleed if cut, such as the lateral umbilical folds, which contain the inferior epigastric arteries.

A peritoneal recess, or fossa, is a pouch of peritoneum that is formed by a peritoneal fold.

Subdivisions of Peritoneal cavity

The transverse mesocolon (mesentery of the transverse colon) divides the abdominal cavity into a supracolic compartment, containing the stomach, liver, and spleen, and an infracolic compartment, containing the small intestine and ascending and descending colon.

Free communication occurs between the supracolic and the infracolic compartments through the paracolic gutters.

The omental bursa is an extensive sac-like cavity that lies posterior to the stomach, lesser omentum and adjacent structures

The omental bursa communicates with the greater sac through the omental foramen. The boundaries of the omental foramen are:

- Anteriorly: the hepatoduodenal ligament
- Posteriorly: the IVC and a muscular band, the right crus of the diaphragm, covered anteriorly with parietal peritoneum (they are retroperitoneal)

- Superiorly: the caudate lobe of the liver
- Inferiorly: the superior part of the duodenum

13. Recessus peritonei, location and clinical importance

The omental bursa has the following boundaries

→ In front: from above downward, by the caudate lobe of the liver, the lesser omentum, the stomach and the anterior two layers of the greater omentum.

→ Behind: from below upward, by two posterior layers of the greater omentum, the transverse colon and the ascending layer of the transverse mesocolon, the upper surface of the pancreas, the left suprarenal gland and the upper end of the left kidney.

→ Laterally: the bursa extends from the epiploic foramen to the spleen, where it is limited by the phrenicolienal and gastrolienal ligaments.

The omental bursa, therefore consists of a series of pouches or recesses to which the following terms are applied:

(1) the vestibule, a narrow channel continued from the epiploic foramen, over the head of the pancreas to the gastropancreatic fold. It contains the left gastric artery and vein

(2) the superior omental recess, between the caudate lobe of the liver and the diaphragm

(3) the lienal recess, between the spleen and the stomach

(4) the inferior omental recess, which comprises the remainder of the bursa.

The superior part of the duodenum is situated intraperitoneally. Its attachment to the liver by the hepatoduodenal ligament allows for movement. The small intestine becomes intraperitoneal again at the duodenojejunal flexure with nearby peritoneal folds and recesses:

- recessus duodenalis inferior → plica duodenalis inferior
- recessus duodenalis superior → plica duodenalis superior
- recessus duodenalis sinister → plica duodenalis lateralis → v. mesenterica inf
- recessus retroduodenalis

located above and below the ileocecal junction and hidden behind the two peritoneal folds, the vascular fold of cecum and the ileocecal fold are:

- recessus ileocecalis superior – plica ileocecalis superior
- recessus ileocecalis inferior - plica ileocecalis inferior
- Recessus retrocecalis

The root of the sigmoid mesocolon contains:

- recessus intersigmoideus

Incarceration of small intestine loops in peritoneal recesses are referred to as internal hernias (Treitz hernias). These can potentially lead to life-threatening intestinal necrosis.

Peritoneal recesses are of clinical importance in connection with the spread

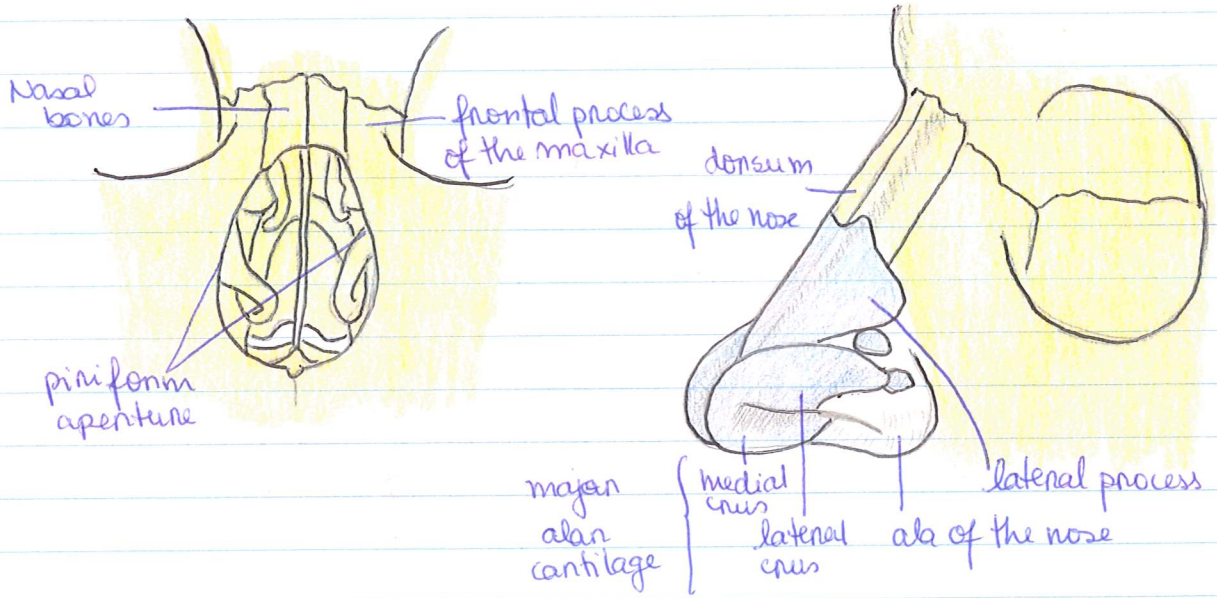
of pathological fluids such as pus. The recesses determine the extent and direction of the spread of fluids that may enter the peritoneal cavity when an organ is diseased or injured.

The peritoneal cavity can also act as a barrier to, and container of, disease. Intra-abdominal infection therefore tends to remain below the diaphragm rather than spread into other body cavities

19. The external nose (nasus externus), the cartilagones nasi

Is made up of an osseocartilaginous framework. The part of the framework formed by the root of the nose is made up of bone. It consists of the two nasal bones and the frontal process of the maxilla which frame the piriform aperture

The piriform aperture is completed by plates and rings of hyaline cartilage known as the nasal cartilages. the paired, triangular cartilaginous plate of the lateral process forms the lateral nasal wall and the dorsum of the nose. It becomes continuous with the cartilage of the nasal septum. The supporting framework of the ala of the nose is formed on each side by the large, curved major alar cartilage and three or four small minor alar cartilages. The major alar cartilage surrounds the nostrils with the lateral crus which bounds them laterally, and the medial crus directed toward the septum. A small groove is formed at the apex of the nose where the two major alar cartilages curve around from either side.



20. Nasal cavity

The nasal cavity is divided into right and left halves by the nasal septum. Each half of the nasal cavity opens posteriorly through an internal nasal aperture, the choana, into the continuation of the nasal cavity, the nasopharynx. Each half of the nasal cavity has a floor, a roof, and a lateral and median wall.

Lateral Wall

• Bony structure - The bony lateral wall of the nasal cavity is formed anteriorly by the maxilla, posteriorly by the perpendicular plate of the palatine and superiorly by the ethmoid contains numerous variously sized ethmoidal cells and forms the bony boundary between the nasal cavity and orbit. The two thin bony plates forming the superior nasal concha and middle nasal concha are also part of the ethmoid, the inferior nasal concha is formed by a separate bone. Each of the conchae projects over a nasal meatus of the same name.

The small, superior nasal concha projects above the superior nasal meatus. Situated between the superior nasal concha, the adjacent body of the sphenoid and the nasal septum is the narrow sphenoethmoidal recess. Immediately below it is the sphenopalatine notch which leads to the pterygopalatine fossa. The large, middle nasal concha covers the middle nasal meatus.

The inferior portion of the ethmoid forms the uncinate process which projects into the middle nasal meatus. Bulging out over the uncinate process is a large anterior ethmoidal cell called the ethmoidal bulla. The thin, inferior nasal concha covers the inferior nasal meatus.

Medial Wall

The nasal septum consists of a bony part, and its anterior portion of a cartilaginous part and membranous part.

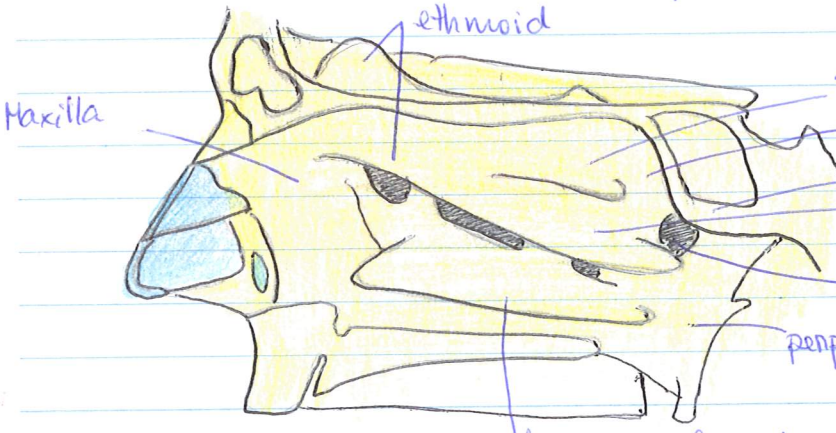
• Bony part - the upper part of the bony nasal septum is formed by the perpendicular plate of the ethmoid. The anterior and superior parts of the bony roof of the nasal cavity are formed by the nasal bone and the nasal part of the frontal bone, the central and superior parts are formed by the cribiform plate of the ethmoid and the posterior part by the body of sphenoid. Articulating with the posteroinferior part of the perpendicular plate of the ethmoid is the vomer. The caudal portion is inserted into the bony floor of the nasal cavity, which is formed by the palatine process of the maxilla and the horizontal plate of the palatine bone. The posterosuperior part of the vomer articulates with the sphenoid. The free posterior margin of the vomer forms the medial boundary of the choana.

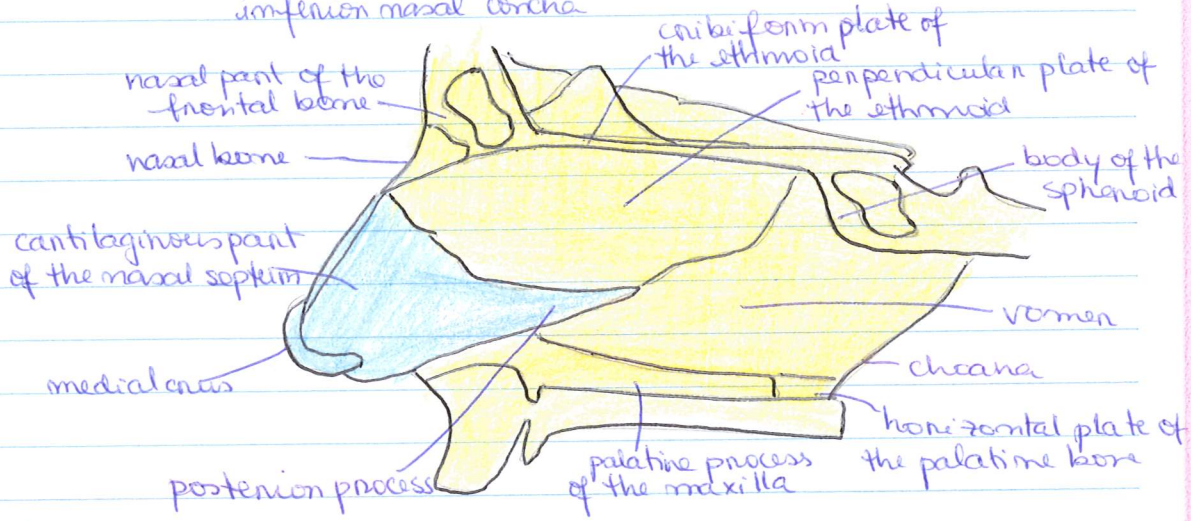
• Cartilaginous and membranous part - extending from the cartilaginous part of the nasal septum the thin, variably long posterior process is inserted into the gap between the two thin bony plates in the anterior part of the nasal septum.

Mucosa

The nasal mucosa can be divided into 3 parts: the anterior nasal vestibule, respiratory region and olfactory region. The nasal vestibule forms the entrance to the nasal cavity and it is lined with skin.

It is separated from the respiratory region by a curved ridge known as the limen nasi. Its mucosa is covered by pseudostratified, ciliated epithelium and contains numerous mixed glands. The olfactory region is a circumscribed area on the lateral nasal wall above the superior nasal concha.





21. Paranasal sinuses

The paranasal sinuses are air-filled extensions of the respiratory part of the nasal cavity into the following cranial bones

- Frontal sinuses

The right and left frontal sinuses are between outer and the inner tables of the frontal bone, posterior to the superciliary arches and the root of the nose.

The right and left sinuses each drain through the frontonasal duct into the ethmoidal infundibulum, which opens into the semilunar hiatus of the middle nasal meatus.

The right and left frontal sinuses are rarely of equal size, and the septum between them is not usually situated entirely in the median plane.

- Ethmoidal cells

The ethmoidal cells (sinuses) are small invaginations of the mucous membrane of the middle and superior nasal meatus into the ethmoid bone between the nasal cavity and the orbit.

The anterior ethmoidal cells drain directly or indirectly into the middle nasal meatus through the ethmoidal infundibulum. The middle ethmoidal cells open directly into the middle meatus and are sometimes called "bullar cells" because they form the ethmoidal bulla.

The posterior ethmoidal cells open directly into the superior meatus.

• Sphenoidal sinuses

The sphenoidal sinuses are located in the body of the sphenoid and may extend into the wings of this bone. They are unevenly divided and separated by a bony septum. They open separately into the sphenoethmoidal recess. superior meatus

• Maxillary sinuses

The maxillary sinuses are the largest of the paranasal sinuses. They occupy the bodies of the maxillae and communicate with the middle nasal meatus.

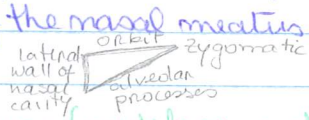
– The apex of the maxillary sinus extends toward and often into the zygomatic bone.

– The base of the maxillary sinus forms the inferior part of the lateral wall of the nasal cavity

– The roof of the maxillary sinus is formed by the floor of the orbit

– The floor of the maxillary sinus is formed by the alveolar part of the maxilla. The roots of the maxillary teeth, particularly the first two molars, often produce conical elevations in the floor of the sinus.

Each maxillary sinus drains by one or more openings, the maxillary ostium into the middle nasal meatus of the nasal meatus of the nasal cavity by way of the semilunar hiatus.



22. The larynx, the skeleton of the larynx (cartilages and their joints)

The larynx has the important task of closing off the lower airways from the pharynx. In addition, it also contributes to the regulation of vocalization, or phonation.

The laryngeal skeleton consists of nine cartilages: three are single (thyroid, cricoid, and epiglottic) and three are paired (arytenoid, corniculate, and cuneiform).

The thyroid cartilage is the largest of the cartilages; its superior border lies opposite the C4 vertebra. The inferior two thirds of its two plate-like laminae fuse anteriorly in the median plane to form the laryngeal prominence. Adam's apple

Superior to this prominence, the laminae diverge to form a V-shaped superior thyroid notch. The less distinct inferior thyroid notch is a shallow indentation in the middle of the inferior border of the cartilage.

The posterior border of each lamina projects superiorly as the superior horn and inferiorly as the inferior horn. The superior border and superior horns attach to the hyoid by the thyrohyoid membrane. The thick median part of this membrane is the median thyrohyoid ligament; its lateral parts are the lateral

thyrohyoid ligaments.

The inferior horns articulate with the lateral surfaces of the cricoid cartilage at the cricothyroid joints. The main movements at these joints are rotation and gliding of the thyroid cartilage, which result in changes in the length of the vocal folds. The cricoid cartilage is shaped like a signet ring with its band facing anteriorly. The posterior part of the cricoid is the lamina, and the anterior part is the arch. The cricoid cartilage is thicker and stronger than the thyroid cartilage and is the only complete ring of cartilage to encircle any part of the airway. It attaches to the inferior margin of the thyroid cartilage by the median cricothyroid ligament and to the first tracheal ring by the cricotracheal ligament.

The arytenoid cartilages are paired, three-sided pyramidal cartilages that articulate with the lateral parts of the superior border of the cricoid cartilage lamina. Each cartilage has an apex superiorly, a vocal process anteriorly and a large muscular process that projects laterally ~~from its and a large muscular process that projects laterally from its and a large muscular process that projects laterally~~ from its base. The apex bears the corniculate cartilage and attaches to the ary-epiglottic fold. The vocal process provides the posterior attachment for the vocal ligament, and the muscular process serves as a lever to which the posterior and lateral crico-arytenoid muscles are attached. The crico-arytenoid joints permit the arytenoid cartilages to slide toward or away from one to another, to tilt anteriorly and posteriorly, and to rotate.

The elastic vocal ligaments extend from the junction of the laminae of the thyroid cartilage anteriorly to the vocal process of the arytenoid cartilage posteriorly.

The vocal ligaments are the thickened, free superior border of the conus elasticus.

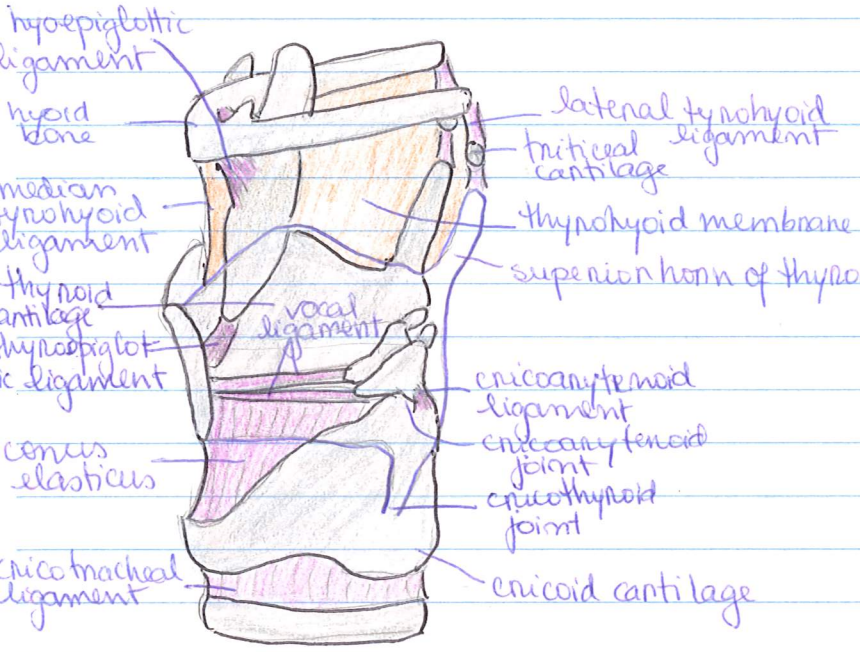
The parts of the membrane extending laterally between the vocal folds and the superior border of the cricoid are the lateral cricothyroid ligaments. The fibroelastic conus elasticus blends anteriorly with the median cricothyroid ligament.

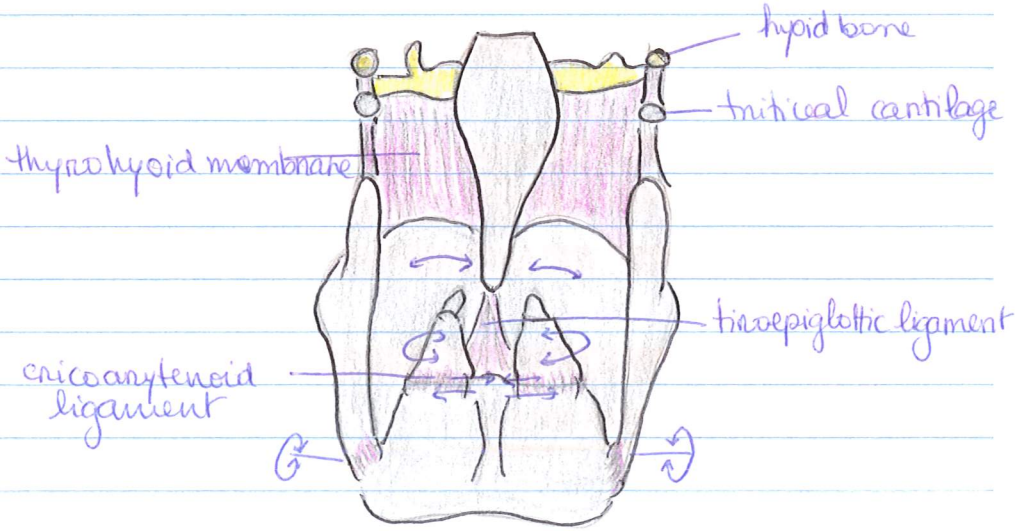
The conus elasticus and overlying mucosa close the tracheal inlet except for the central rima glottidis.

The epiglottic cartilage, consisting of elastic cartilage, is situated posterior to the root of the tongue and the hyoid and anterior to the laryngeal inlet, the epiglottic cartilage forms the superior part of the anterior wall and the superior margin of the inlet. Its broad superior end is free. Its tapered inferior end, the stalk of the epiglottis, is attached to the angle formed by the thyroid laminae by

by the thyro-epiglottic ligament. The hyo-epiglottic ligament attaches the anterior surface of the epiglottic cartilage to the hyoid.

The quadrangular membrane is a thin, submucosal sheet of connective tissue that extends between the lateral aspects of the arytenoid and epiglottic cartilages. Its free inferior margin constitutes the vestibular ligament, which is covered loosely by mucosa to form the vestibular fold. This fold lies superior to the fold and extends from the thyroid cartilage to the arytenoid cartilage. The free superior margin of the quadrangular membrane forms the ary-epiglottic ligament, which is covered with mucosa to form the ary-epiglottic fold. The corniculate and cuneiform cartilages appear as small nodules in the posterior part of the ary-epiglottic folds. The corniculate cartilages attach to the apices of the arytenoid cartilages; the cuneiform cartilages do not directly attach to other cartilages.

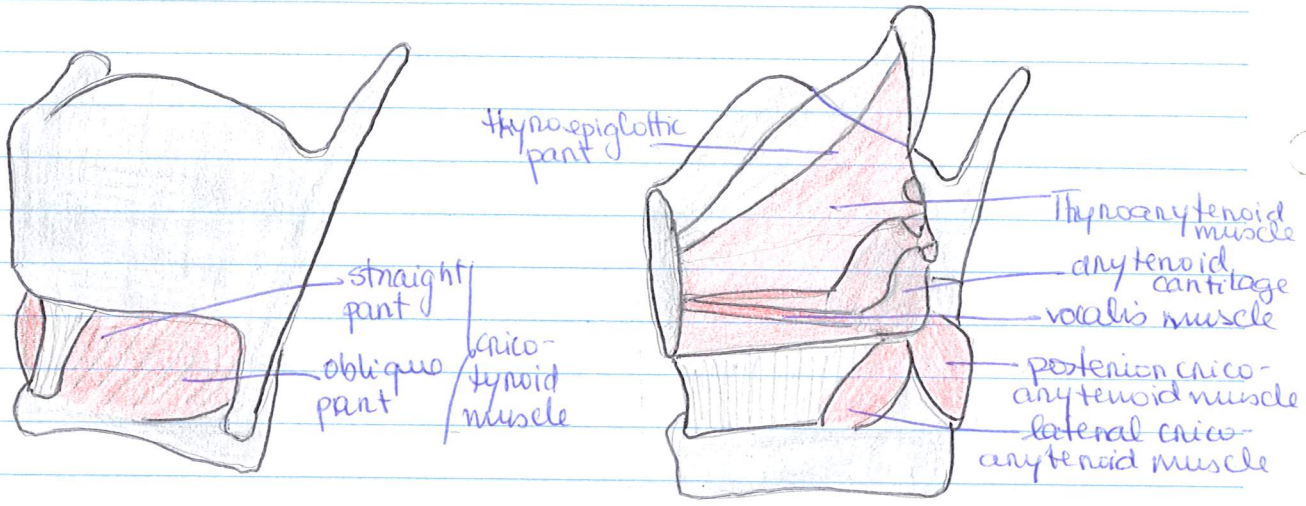


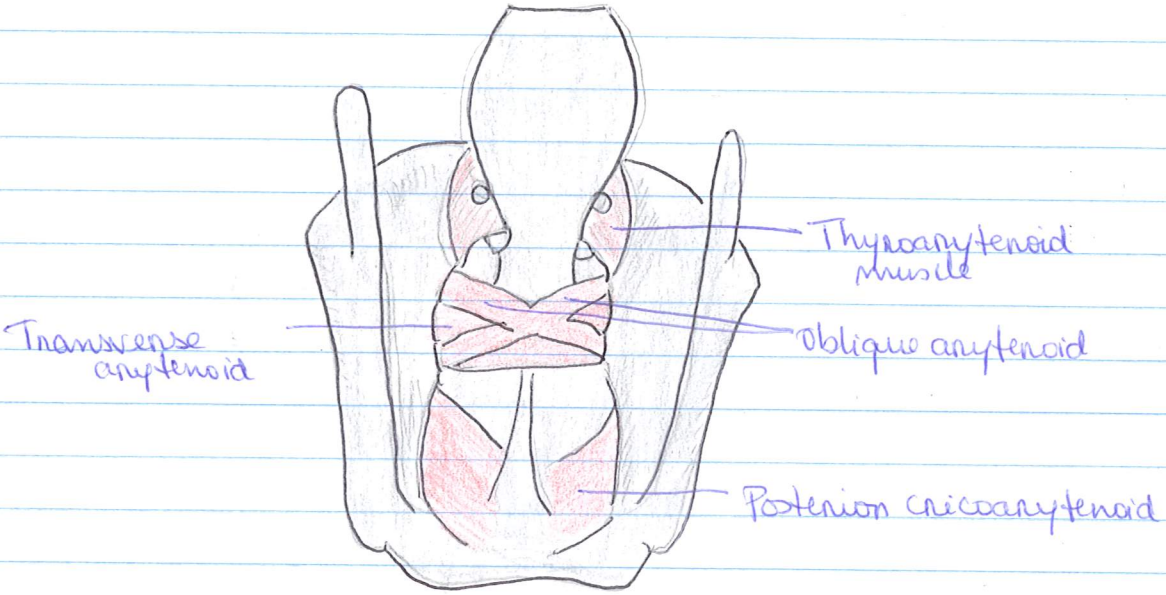


23. The laryngeal muscles and their involvement in the inspiration and expiration

MUSCLE	ORIGIN	INSERTION	INNERVATION
Cricothyroid	Anterolateral part of cricoid cartilage	Inferior margin and inferior horn of thyroid cartilage	External laryngeal nerve (from n. X) sup. laryngeal n.
FUNCTION: Stretches and tenses vocal ligament			
Thyro-arytenoid	Lower half of posterior aspect of angle of thyroid laminae and cricothyroid ligament	Anterolateral arytenoid surface	Inferior laryngeal nerve (terminal part of recurrent laryngeal nerve, from n. X)
FUNCTION: Relaxes vocal ligament			
Posterior crico-arytenoid	Posterior surface of lamina of cricoid cartilage	Muscular process of arytenoid cartilage	Inferior laryngeal nerve (terminal part of recurrent laryngeal nerve, from n X)
FUNCTION: Abducts vocal folds			
Lateral crico-arytenoid	Arch of cricoid cartilage	Muscular process of arytenoid cartilage	Inferior laryngeal nerve (terminal part of recurrent laryngeal nerve, n. X)
FUNCTION: Adducts vocal folds (intercartilaginous portion)			
Transverse and oblique arytenoids	One arytenoid cartilage	Contralateral arytenoid cartilage	Inferior laryngeal nerve (terminal part of recurrent laryngeal nerve, from n. X)
FUNCTION: Adduct arytenoid cartilages (adducting intercartilaginous portion of vocal folds, closing posterior rima glottidis)			
Vocalis	Lateral surface of vocal process of arytenoid cartilage	Ipsilateral vocal ligament	Inferior laryngeal nerve (terminal part of recurrent laryngeal nerve, from n. X)
FUNCTION: Relaxes posterior vocal ligament while maintaining (or increasing) tension of anterior part			

During breathing the rima glottidis is narrow and wedge shaped; during forced respiration, it is wide and trapezoidal in shape → function of the posterior crico-arytenoid muscle.





24. Interior of the larynx (cavum laryngis); laryngoscopic views

It is divided by two pairs of lateral folds, one above the other, into upper, middle, and lower.

- Upper part - the obliquely oriented laryngeal inlet leads to the laryngeal vestibule which extends as far as the vestibular folds. The laryngeal inlet is limited by the epiglottis and two mucosal folds known as the aryepiglottic folds.

Between the two arytenoid cartilages is a posterior notch in the mucosa called the interarytenoid notch. On either side of the laryngeal inlet is the inferior part of the pharynx which contains a trench in the mucosa known as the piriform recess.

- Middle part - intermediate laryngeal cavity, extends from the vestibular folds to the vocal folds. It is expanded on either side by a mucosal outpouching, the laryngeal ventricle and ends anterosuperiorly in a blind pouch called the laryngeal saccule.

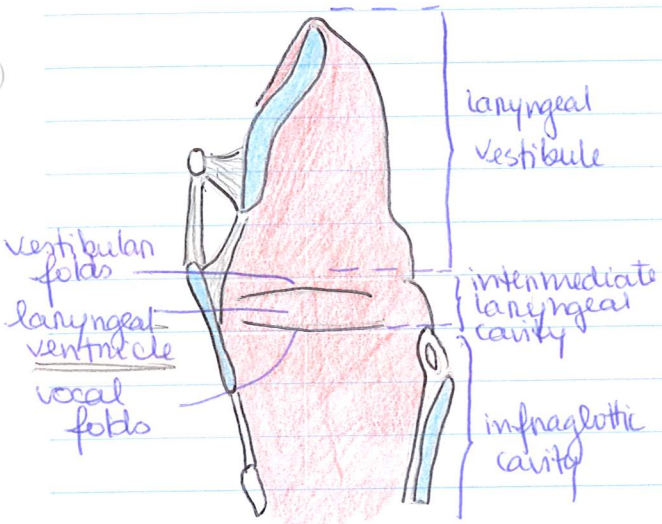
- lower part - infraglotic cavity, reaches from the vocal folds to the inferior margin of the cricoid cartilage.

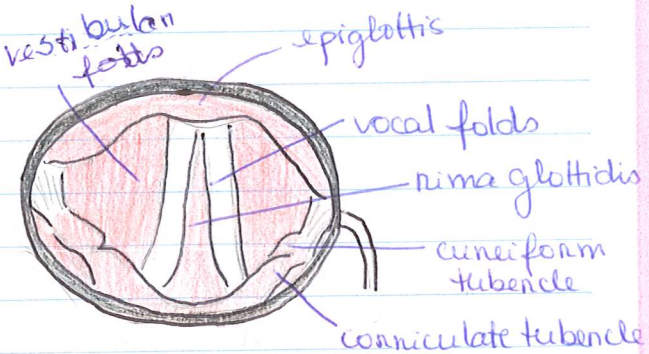
The wall of the infraglottic cavity is formed almost entirely by the conus elasticus.

→ Vestibular folds (false vocal cords) contain the vestibular ligament formed by the free inferior margin of the quadrangular membrane as well as numerous glands.

The space between the vestibular folds on either side is called rima vestibuli

→ Vocal folds contain the vocal ligament and vocalis muscle. They bound the anterior part of the rima glottidis.





25. The lungs (pulmo), segmentation

The lungs are the vital organs of respiration. Their main function is to oxygenate the blood by bringing inspired air into close relation with the venous blood in the pulmonary capillaries.

• External surface

Each of the two lungs consists of adome-like apex, which projects a few centimetres above the superior thoracic aperture. The base of lung or diaphragmatic surface, is concave and lies on the diaphragm. The outer surface of the lung resting against the rib is convex and is known as the costal surface. The surface facing the mediastinum, the mediastinal surface is divided by the hilum of lung. Each of the mediastinal surfaces has an indentation produced by the heart, the cardiac impression. On the medial surface of the right lung are impressions produced by the right subclavian artery, azygos vein, and esophagus. The surface of the left lung is marked by visible grooves from the aortic arch, thoracica aorta and left subclavian artery.

Laterally and posteriorly, the diaphragmatic surface is bounded by a thin, sharp margin (inferior border) that projects into the costodiaphragmatic recess of the pleura.

• Hilum of lung

The root of the lung is formed by the collection of vessels and bronchi that enter and leave the lung in the centre of its medial surface. These connect the lungs with the heart and trachea.

If the lung root is sectioned before the branching of the main bronchus and pulmonary artery, its general arrangement is

→ Pulmonary artery: superiormost on left (the superior lobar or "eparterial" bronchus may be superiormost on the right).

→ Superior and inferior pulmonary veins: anteriormost and inferiormost, respectively.

→ Main bronchus: against and approximately in the middle of the posterior boundary, with the bronchial vessels coursing on its outer surface (usually on posterior aspect)

The structures that enter and leave the lung at the hilum are completely surrounded by a reflection of pleura, which extends caudally in front of the cardiac impression. → pulmonary ligament.

• Lung borders

The costal surface and mediastinal surface meet anteriorly at the sharp anterior border.

Between the costal surface and diaphragmatic surface is the inferior margin.

• Lung lobes and fissures

Each lung is divided into lobes by deep depressions, or fissures. The right lung normally has a superior lobe, middle lobe, and inferior lobe. The superior lobe and inferior lobe are divided by the oblique fissure which runs diagonally from posterosuperior to anteroinferior. The superior lobe and middle lobe are divided by the horizontal fissure lying anteriorly and laterally. The smaller left lung consists of only a superior lobe and inferior lobe which are also separated by an oblique fissure. The anteroinferior end of the superior lobe of the left lung usually has a tongue-like projection known as the lingula.

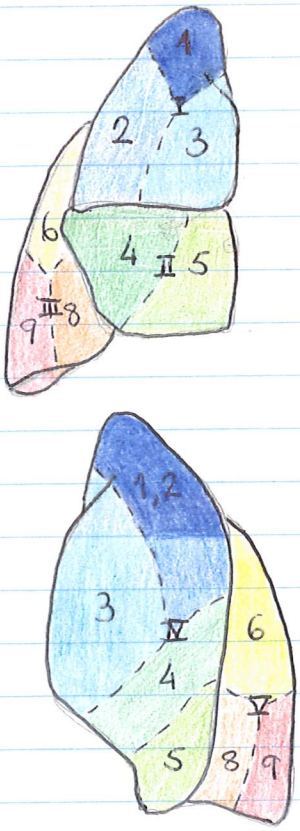
• Tracheobronchial tree

- The right main bronchus is wider, shorter, and runs more vertically than the left main bronchus as it passes directly to the hilum of the lung.
- The left main bronchus passes inferolaterally, inferior to the arch of the aorta and anterior to the esophagus and thoracic aorta, to reach the hilum of the lung.

Each main bronchus divides into secondary lobar bronchi, two on the left and three on the right, each divides into several tertiary segmental bronchi that supply the bronchopulmonary segments.

The bronchopulmonary segments are:

- The largest subdivisions of a lobe.
- Pyramidal-shaped segments of the lung with their apices facing the lung root.
- Separated from adjacent segments by connective tissue septa.
- Supplied independently by a segmental bronchus and a tertiary branch of the pulmonary artery.
- Drained by intersegmental parts of the pulmonary veins that lie in the connective tissue.
- Usually 18-20 in number (10 in the right lung; 8-10 in the left lung)



I - Right superior lobar bronchus; II - Right middle lobar bronchus; III - Right inferior lobar bronchus
1 - Apical segment and apical segmental bronchus; 2 - Posterior segment and posterior segmental bronchus
1+2 Apicoposterior segment and apicoposterior segmental bronchus; 3 - Anterior segment and anterior segmental bronchus; 4 - Lateral segment and lateral segmental bronchus; 5 - Medial segment and medial segmental bronchus; 6 - Superior segment and superior segmental bronchus; 7 - Medial basal segment and medial basal segmental bronchus; 8 - Anterior basal segment and anterior basal segmental bronchus; 9 - Lateral basal segment and lateral basal segmental bronchus; 10 - Posterior basal segment and posterior basal segmental bronchus

26. The visceral and parietal pleura

Each lung is invested by and enclosed in a serous pleural sac that consists of two continuous membranes: the visceral pleura, which invests all surfaces of the lungs forming their shiny outer surface, and the parietal pleura, which lies the pulmonary cavities.

The pleural cavity - the potential space between the layers of pleura - contains a capillary layer of serous pleural fluid, which lubricates the pleural surfaces and allows the layers of pleura to slide smoothly over each other during respiration.

The lung expands and fills with air when the thorax expands while still allowing sliding to occur, much like a film of water between two glass plates.

The visceral pleura closely covers the lung and adheres to all its surfaces, including those within the horizontal and oblique fissures.

The visceral pleura is continuous with the parietal pleura at the hilum of the lung, where structures making up the root of the lung enter and leave the lung.

The parietal pleura is thicker than the visceral pleura. The parietal pleura consists of three parts - costal, mediastinal, and diaphragmatic - and the cervical pleura.

The costal part of the parietal pleura covers the internal surfaces of the thoracic wall.

The mediastinal part of the parietal pleura covers the lateral aspects of the mediastinum. It continues superiorly into the root of the neck as cervical pleura. It is continuous with costal pleura anteriorly and posteriorly and with the diaphragmatic pleura inferiorly. At the hilum of the lung, it is the mediastinal pleura that reflects laterally onto the root of the lung to become continuous with the visceral pleura

The diaphragmatic part of the parietal pleura covers the superior (thoracic) surface of the diaphragm on each side of the mediastinum, except along its costal attachments and where the diaphragm is fused to the pericardium, the fibroserous membrane surrounding the heart. The phrenicopleural fascia, connects the diaphragmatic pleura with the muscular fibers of the diaphragm.

The cervical pleura covers the apex of the lung. It is a superior continuation of the costal and mediastinal parts of the parietal pleura. The cervical pleura forms a cup-like dome over the apex that reaches its summit 2-3 cm superior to the level of the medial third of the clavicle at the level of the neck of the 1st rib.

The sternal line of pleural reflection on the right side continues to pass inferiorly in the anterior median line (AML), only to the level of the 4th costal cartilage. Here it passes to the left margin of the sternum and continues inferiorly to the 6th costal cartilage, creating a shallow notch as it runs lateral to an area of direct contact between the pericardium and the anterior thoracic wall.

The right costal line proceeds laterally from the AML.

The left costal line begins at the midclavicular line. Passing obliquely across the 8th rib in the midclavicular line (MCL) and the 10th rib in the midaxillary line (MAL) becomes continuous posteriorly with the vertebral lines at the necks of the 12th ribs inferior to them.

The vertebral lines of pleural reflection parallel the vertebral column, running in the paravertebral planes from vertebral level T1 through T2, where they become continuous with the costal lines.

The lungs do not fully occupy the pulmonary cavities during expiration, thus the peripheral diaphragmatic pleura is in contact with the lowermost

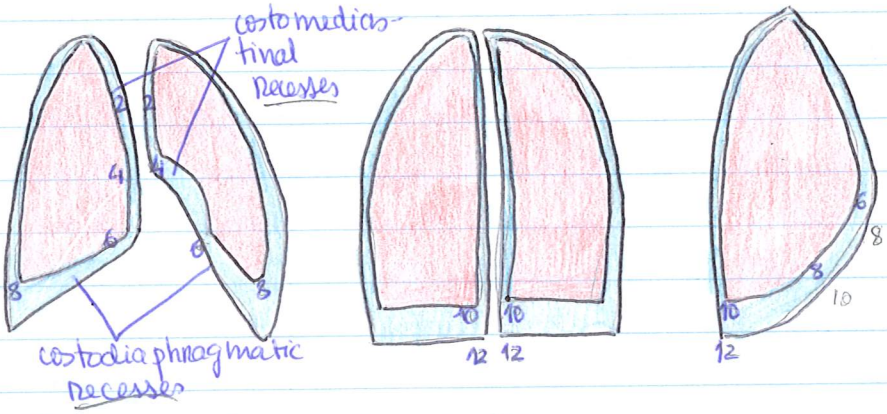
Pleura	Para sternal	MCL	AAL	MAL	PAL	MS	SL
Dcha.	2nd – 6th	7th	8th	9th	10th	11th	T12
Esquerda	2nd – 4th	7th	8th	9th	10th	11th	T12

Lung → 1 level up

pants of the costal pleura. The potential pleural spaces here are the costodiaphragmatic recesses.

Similar but smaller pleural recesses are located posterior to the sternum where the costal pleura is in contact with the mediastinal pleura. The potential pleural spaces here are the costomediastinal recesses.

This inferior borders of the lungs move farther into the pleural recesses during deep inspiration and retreat from them during expiration.



27. The inspiration and expiration

The exchange of gases between the pulmonary alveoli and the environment requires pressure changes in the thorax. These are generated by active and passive forces.

The bony framework of the thoracic wall is formed by the ribs, thoracic vertebrae and sternum. The main muscles responsible for movement of the bony thorax are the intercostal muscles situated between the ribs, and the scalene muscles. The diaphragm, which divides the abdominal and thoracic cavities, is another important respiratory muscle. The volume of the lung increases or decreases during inspiration or expiration as the thoracic cavity expands or contracts. Because it adheres to the thoracic wall, the surface of the lung follows the expansion of the thorax although, because of its own elasticity, the lung has a tendency to contract toward the hilum.

Inspiration

During inspiration the thoracic cavity and lung volume enlarge. The ribs move upward, thereby increasing the transverse and sagittal diameters of the thorax and enlarging the epigastric angle. This requires the action of the scalene muscles and/or external intercostal muscles. Contraction of the diaphragm causes the central tendon of the diaphragm to descend, the domes of the diaphragm to flatten, and the thorax to expand caudally. The deeper the inspiration, the flatter the costodiaphragmatic recess becomes, allowing the inferior border of the lung to expand further into this supplementary space.

Expiration

During expiration the thoracic cage and lung volume decrease again. During quiet respiration the elastic thoracic cage returns to its original position, the resting position of the thorax. Its transverse and sagittal diameters decrease, in turn reducing the epigastric angle. Contraction of the expiratory internal intercostal muscles can aid this process. The domes of the diaphragm move upward, decreasing the size of inferior portion of the thoracic cavity.

28. The Kidneys (ren)

The ovoid Kidneys remove excess water, salts, and wastes of protein metabolism from the blood while returning nutrients and chemicals to the blood. They lie retroperitoneally on the posterior abdominal wall, one on each side of the vertebral column at the level of the T12 - L3 vertebrae.

The renal hilum is the entrance to a space within the kidney, the renal sinus. Structures that serve the kidneys (vessels, nerves, and structures that drain urine from the kidney) enter and exit the renal sinus through the renal hilum. The hilum of the left kidney lies near the transpyloric plane, approximately 5 cm from the median plane. The transpyloric plane passes through the superior pole of the right kidney, which is approximately 2,5 cm lower than the left pole, probably due to the presence of the liver. Posteriorly, the superior parts of the kidneys lie deep to the 11th and 12th ribs.

Each kidney moves 2-3 cm in a vertical direction during the movement of the diaphragm that occurs with deep breathing.

The inferior pole of the right kidney is approximately a finger's breadth superior to the iliac crest.

The kidneys measure approximately 10 cm in length, 5 cm in width and 2,5 cm in thickness.

More inferiorly, the posterior surfaces of the kidney are related to the psoas major muscles medially and quadratus lumborum muscle.

The liver, duodenum and ascending colon are anterior to the right kidney. The left kidney is related to the stomach, spleen, pancreas, jejunum, and descending colon.

At the hilum, the renal vein is anterior to the renal artery, which is anterior to the renal pelvis. Within the kidney, the renal sinus is occupied by the renal pelvis, calices, vessels, and nerves, and a variable amount of fat. Each kidney has anterior and posterior surfaces, medial and lateral margins, and superior and inferior poles.

The lateral margin of each kidney is convex, and the medial margin is concave where the renal sinus and renal pelvis are located.

Internal structure

A cross-section or longitudinal section of the kidney reveals two distinct regions forming its internal structure: the renal medulla and the outer renal cortex.

Renal medulla - the renal medulla is composed of conical renal pyramids. The bases of the renal pyramids are directed toward the surface of the kidney. The rounded apices form the renal papillae which project toward the hilum and into the renal calices of the renal pelvis. On its surface, each renal papilla bears a cribiform area of numerous perforations produced by the openings of the uniniferous tubules. → tubules from kidney

Renal cortex - the renal cortex lies immediately beneath the fibrous capsule. It overlies the pyramids of the renal medulla like a capsule between the lateral aspects of the renal pyramids sending extensions called renal columns.

→ Kidney lobes - each kidney lobe consists of a renal pyramid and its surrounding cortex. Individual kidney lobes are bounded by the renal columns.

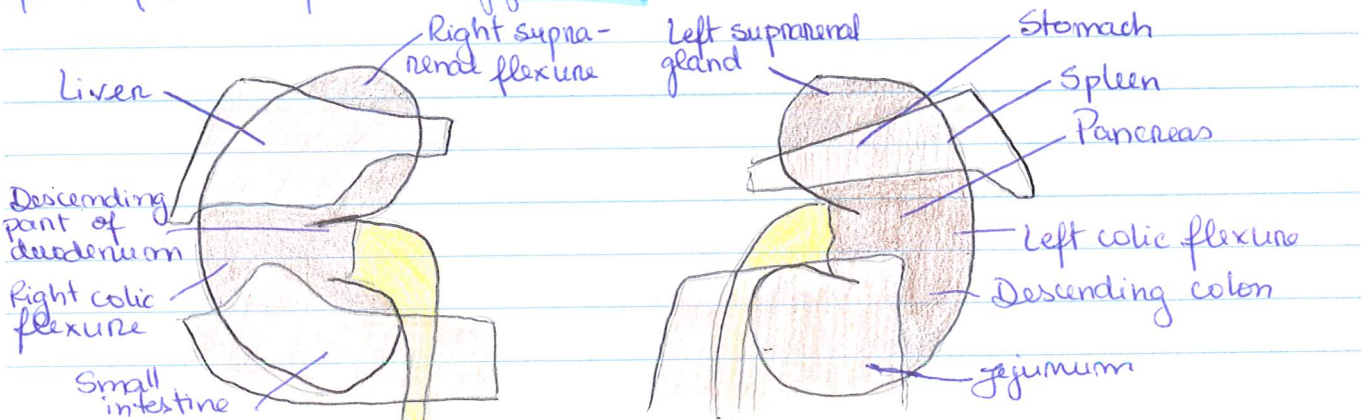
Relationship to other structures

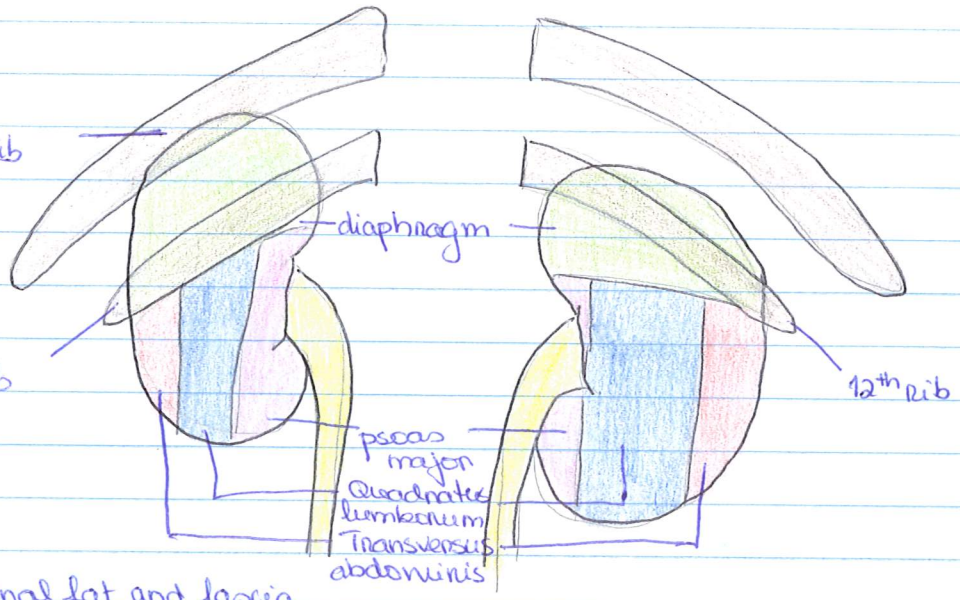
The anterior surface of the right kidney is related to numerous structures:

- a small part of the superior pole is covered by the right suprarenal gland
- moving inferiorly, a large part of the rest of the upper part of the anterior surface is against the liver and is separated from it by a layer of peritoneum
- medially, the descending part of the duodenum is retroperitoneal and contacts the kidney
- the inferior pole of the kidney, on its lateral side, is directly associated with the right colic flexure and, on its medial side, is covered by a segment of the intraperitoneal small intestine.

The anterior surface of the left kidney is also related to numerous structures:

- a small part of the superior pole, on its medial side, is covered by the left suprarenal gland
- the rest of the superior pole is covered by the intraperitoneal stomach and spleen
- moving inferiorly, the retroperitoneal pancreas covers the middle part of the kidney
- on its lateral side, the lower half of the kidney is covered by the left colic flexure and the beginning of the descending colon, and, on its medial side, by the parts of the intraperitoneal jejunum.





Renal fat and fascia

Immediately outside the renal capsule, there is an accumulation of extraperitoneal fat - the perinephric fat (perirenal fat), which completely surrounds the kidney. Enclosing the perinephric fat is a membranous condensation of the extraperitoneal fascia (the renal fascia). opened laterally and inferiorly

In addition to perinephric fat and the renal fascia, a final layer of paranephric fat (pararenal fat) completes the fat and fascias associated with the kidney. This fat accumulates posterior and posterolateral to each kidney.

29. The renal calix, pelvis and ureter

7-14 minor The renal pelvis is a reservoir for the collection of urine formed by the union of the 8-10 renal calices that empty into it. Minor calices are small, trumpet-shaped renal calices that surround one renal papilla. They give rise to the 2-3 major calices which open into the renal pelvis.

The volume of the renal pelvis is 2-5 ml functional.

Ureter - thick-walled tube that connects the renal pelvis with the urinary bladder. It is 25-30 cm long and is divided into 3 parts based on its course: an abdominal part, a pelvic part and an intramural part. The abdominal part of the ureter begins at its exit from the renal pelvis with the first point of constriction of the ureter. The ureter then proceeds caudally to the medial side of the psoas major where it lies between the muscle fascia (posterior to it) and the peritoneum (covering its anterior aspect). During its course, the path of the ureter is crossed over by the testicular or ovarian vein, and the ureter itself crosses over the genitofemoral nerve. It enters the lesser pelvis at the level of the common iliac vessels or external iliac vessels. This is the site of the second point of constriction of the ureter. The third point is where the ureters enter the wall of the bladder.

30. The urinary bladder (vesica urinaria) and female urethra

When empty, the adult urinary bladder is located in the lesser pelvis, lying partially superior to and partially posterior to the pubic bones. It is separated from these bones by the potential retropubic space (of Retzius) and lies mostly inferior to

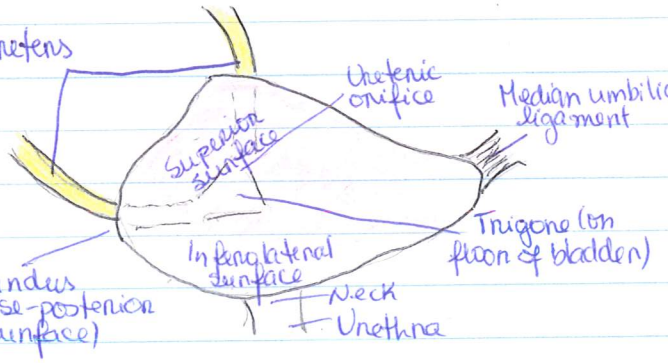
the peritoneum, resting on the pubic bones and pubic symphysis anteriorly and the prostate (males) or anterior wall of the vagina posteriorly. The bladder is relatively free within the extraperitoneal subcutaneous fatty tissue, except for its neck, which is held firmly by the lateral ligaments of bladder and the tendinous arch of the pelvic fascia - especially its anterior component, the puboprostatic ligament in males and the pubovesical ligament in females. In females, since the posterior aspect of the bladder rests directly upon the anterior wall of the vagina, the lateral attachment of the vagina to the tendinous arch of the pelvic fascia, the paracolpium, is an indirect but important factor in supporting the urinary bladder.

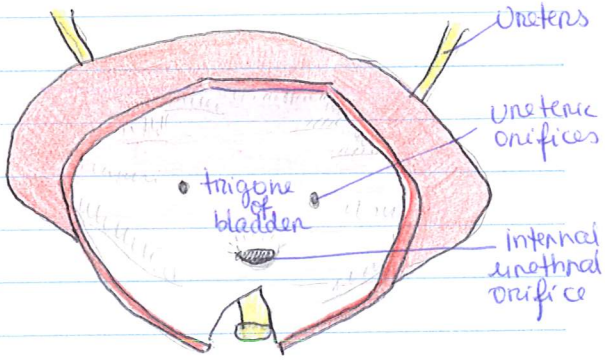
Parts of urinary bladder - the body of bladder constitutes the largest part of the organ. It is continuous anterosuperiorly with the apex of bladder. The apex gives attachment to the median umbilical ligament to the navel. Opening into the lateral and posterior aspects of the fundus of bladder which empties posteriorly and inferiorly, are the ureters. The neck of bladder is continuous anteriorly with the urethra.

The capacity of the urinary bladder is normally about 500 ml.; the urge to void occurs at about 300 ml.

Internal surface - two parts can be identified: throughout most of the urinary bladder the mucosa contains folds due to its mobility against the underlying muscular layer. When the bladder is very full, the folds disappear. The triangular region formed on the fundus of the bladder, which is bounded by the two openings of the ureters known as the ureteric orifices and the exit of the urethra called the internal urethral orifice is known as the trigone of bladder. The mucosa of the trigone of the bladder is flat. In the male, the uvula of bladder, a conical elevation produced by the underlying prostate, projects into the internal urethral orifice.

The walls of the bladder are composed chiefly of the detrusor muscle. Toward the neck of the male bladder, the muscle fibers form the involuntary internal urethral sphincter. This sphincter contracts during ejaculation to prevent retrograde ejaculation (ejaculatory reflux) of semen into the bladder.





31. The scrotum, the descent of the testis, the sheaths of testis and spermatic cord

The scrotum is a cutaneous sac consisting of two layers: heavily pigmented skin and the closely related dartos fascia, a fat-free fascial layer including smooth muscle fibers (dartos muscle) responsible for the rugose (wrinkled) appearance of the scrotum. Because the dartos muscle attaches to the skin, its contraction causes the scrotum to wrinkle when cold, thickening the integumentary layer and assisting the cremaster muscles in holding the testes closer to the body, all of which reduces heat loss.

The scrotum is divided internally by a continuation of the dartos fascia, the septum of the scrotum, into right and left compartments. The septum is demarcated externally by the scrotal raphe. It is continuous anteriorly with the membranous layer of subcutaneous tissue of the abdomen (Scarpa fascia) and posteriorly with the membranous layer of subcutaneous tissue of the perineum.

The development of the scrotum is closely related to the formation of the inguinal canals.

Late in the fetal period, the testes and spermatic cords enter the scrotum.

The descent of the testis

The testes develop in the extraperitoneal connective tissue in the superior lumbar region of the posterior abdominal wall. The male gubernaculum is a fibrous tract connecting the primordial testis to the anterolateral abdominal wall at the site of the future deep ring of the inguinal canal. A peritoneal diverticulum, the processus vaginalis, transverses the developing inguinal canal, carrying muscular and fascial layers of the anterolateral abdominal wall before it as it enters the primordial scrotum. By the 12th week, the testis is in the pelvis and by 28 weeks (7th months), it lies close to the developing deep inguinal ring. The testis begins to pass through the inguinal canal during the 28th week and takes approximately 3 days to traverse it. Approximately 4 weeks later, the testis enters the scrotum. As the testis, its duct (ductus deferens), and its vessels and nerves relocate, they are ensheathed by musculofascial extensions of the anterolateral abdominal wall, which account for the presence of their derivatives in the adult scrotum: the internal and external spermatic fasciae and cremaster muscle.

Layers of abdominal wall	Scrotum and coverings of Testis
Skin	Skin
Subcutaneous tissue	Subcutaneous tissue (dartos) and dartos m.
External oblique muscle	External spermatic fascia
Internal oblique muscle	Cremaster muscle
Fascia of both superficial and deep surfaces of the internal oblique muscle	Cremasteric fascia
Transversus abdominis muscle	
Transversalis fascia	Internal spermatic fascia
Peritoneum	Tunica vaginalis ◦ Parietal - PERIORCHIUM ◦ Visceral - EPIORCHIUM

Spermatic cords

The spermatic cord begins at the deep inguinal ring lateral to the inferior epigastric vessels, passes through the inguinal canal, exits at the superficial inguinal ring, and ends in the scrotum at the posterior border of the testis.

The coverings of the spermatic cord include the following:

- Internal spermatic fascia: derived from the transversalis fascia
- Cremasteric fascia: derived from the fascia of both the superficial and the deep surfaces of the internal oblique muscle.
- External spermatic fascia: derived from the external oblique aponeurosis and its investing fascia.

The cremasteric fascia contains loops of cremaster muscle, which is formed by the lowermost fascicles of the internal oblique muscle arising from the inguinal ligament. The cremaster muscle reflexively draws the testis superiorly in the scrotum, particularly in response to cold. This response occurs in an attempt to regulate the temperature of the testis for spermatogenesis (formation of sperms), which requires a constant temperature approximately one degree cooler than core temperature. The cremaster typically acts coincidentally with the dartos muscle, smooth muscle of the fat-free subcutaneous tissue of the scrotum (dartos fascia) which inserts into the skin.

Although less well developed and usually indistinct, the round ligament of the female receives similar contributions from the layers of the abdominal wall as it traverses the inguinal canal. The constituents of the spermatic cord are the following.

- Ductus deferens (vas deferens): a muscular tube approximately 45 cm long that conveys sperms from the epididymis to the ejaculatory duct.
- Testicular artery: arising from the aorta and supplying the testis and epididymis.
- Artery of ductus deferens: arising from the inferior vesical artery.
- Cremasteric artery: arising from the inferior epigastric artery
- Pampiniform venous plexus
- Sympathetic nerve fibers and parasympathetic nerve fibers on the ductus deferens
- Genital branch of the genitofemoral nerve: supplying the cremaster muscle.
- Lymphatic vessels: draining the testis and closely associated structures and passing to the lumbar lymph nodes.
- Vestige of processus vaginalis

32. The testis and epididymis

The testes (testicles) are the male gonads - paired ovoid reproductive glands that produce sperms (spermatozoa) and male hormones, primarily testosterone. The testes are suspended in the scrotum by the spermatic cords.

The surface of each testis is covered by the visceral layer of the tunica vaginalis, except where the testis attaches to the epididymis and spermatic cord.

The visceral layer of the tunica vaginalis is closely applied to the testis, epididymis, and inferior part of the ductus deferens. The slit-like recess of the tunica vaginalis, the sinus of the epididymis, is between the body of the epididymis and the posterolateral surface of the testis.

The parietal layer of the tunica vaginalis, adjacent to the internal spermatic fascia, is more extensive than the visceral layer and extends superiorly for a short distance onto the distal part of the spermatic cord. The small amount of fluid in the cavity of the tunica vaginalis separates the visceral and parietal layers, allowing the testis to move freely in the scrotum.

The testes have a tough fibrous outer surface, the tunica albuginea, that thickens into a ridge on its internal, posterior aspect as the mediastinum of the testis. From this internal ridge, fibrous septa extend inward between lobules of minute but long and highly coiled seminiferous tubules in which the sperms are produced. The seminiferous tubules are joined by straight tubules to the rete testis, a network of canals in the mediastinum of the testis.

Epididymis

The epididymis is an elongated structure on the posterior surface of the testis. Efferent ductules of the testis transport newly developed sperms to the epididymis from the rete testis. The epididymis is formed by minute convolutions of the duct of the epididymis, so tightly compacted that they appear solid. The duct becomes progressively smaller as it passes from the head of the epididymis on the superior part of the testis to its tail. At the tail of the epididymis, the ductus deferens begins as the continuation of the epididymal duct. In the lengthy course of this duct, the sperms are stored and continue to mature. The epididymis consists of the:

- Head of the epididymis: the superior expanded part that is composed of lobules formed by the coiled ends of 12-14 efferent ductules.
- Body of the epididymis: consists of the ~~consists of~~ the convoluted duct of the epididymis.
- Tail of the epididymis: continuous with the ductus deferens, the duct that transports the sperms from the epididymis of the ejaculatory duct for expulsion via the urethra during ejaculation.

33. The funiculus spermaticus, ductus deferens, vesicula seminalis

Spermatic cord

The spermatic cord consists of the ductus deferens and its accompanying vessels (testicular artery and vein, artery to ductus deferens, pampiniform venous plexus, autonomic nerves, and the genital branch of the genitofemoral nerve). It extends from the head of the epididymis to the deep inguinal ring and is covered by the internal spermatic fascia investing the cremaster muscle

Ductus deferens

The ductus deferens (vas deferens) is the continuation of the duct of the epididymis. The ductus deferens:

- Has relatively thick muscular walls and a minute lumen, giving it a cord-like firmness.
- Begins in the tail of the epididymis, at the inferior pole of the testis.
- Ascends posterior to the testis, medial to the epididymis
- Is the primary component of the spermatic cord
- Penetrates the anterior abdominal wall via the inguinal canal.
- Crosses over the external iliac vessels and enters the pelvis
- Passes along the lateral wall of the pelvis, where it lies external to the parietal peritoneum
- Ends by joining the duct of the seminal gland to form the ejaculatory duct.

During the pelvic part of its course, the ductus deferens maintains direct contact with the peritoneum; no other structure intervenes between them. The duct crosses superior to the ureter near the posterolateral angle of the bladder running between the ureter near the posterolateral angle of the bladder, running between the ureter and the peritoneum of the ureteric fold to reach the fundus of the bladder.

Posterior to the bladder, the ductus deferens at first lies superior to the seminal gland, then descends medial to the ureter and the gland. Here the ductus deferens enlarges to form the ampulla of the ductus deferens before its termination.

Seminal glands

Each seminal gland (vesicle) is an elongated structure (approximately 5cm long but sometimes much shorter) that lies between the fundus of the bladder and the rectum. The seminal glands are obliquely placed superior to the prostate and DO NOT store sperms. They secrete a thick alkaline fluid with fructose (an energy source for sperms) and a coagulating agent that mixes with the sperms as they pass into the ejaculatory ducts and urethra.

The superior ends of the seminal glands are covered with peritoneum and lie posterior to the ureters, where the peritoneum of the rectovesical pouch separates

them from the rectum.

The duct of the seminal gland joins the ductus deferens to form the ejaculatory duct → opens in prostatic urethra

34. The prostate

The prostate (approximately 3 cm long, 4 cm wide, and 2 cm in AP depth) is the largest accessory gland of the male reproductive system and surrounds the prostatic urethra. The glandular part makes up approximately two thirds of the prostate, the other third is fibromuscular.

The prostate has:

- A base closely related to the neck of the bladder
- An apex that is in contact with fascia on the superior aspect of the urethral sphincter and deep perineal muscles.
- A muscular anterior surface which is part of the urethral sphincter
- A posterior surface that is related to the ampulla of the rectum
- Inferolateral surfaces that are related to the levator ani.

Although not clearly distinct anatomically, the following lobes of the prostate are traditionally described:

- The isthmus of the prostate (anterior lobe) lies anterior to the urethra.
- Right and left lobes of the prostate, separated anteriorly by the isthmus and posteriorly by a central, shallow longitudinal furrow, may each be subdivided for descriptive purposes into four indistinct lobules defined by their relationship to the urethra and ejaculatory ducts, and - although less apparent - by the arrangement of the ducts and connective tissue:

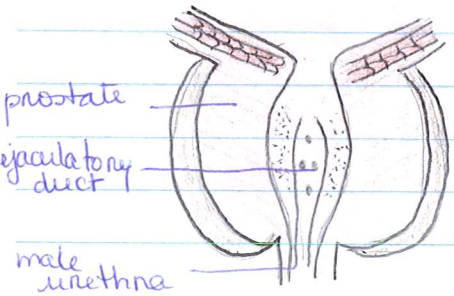
(1) an inferoposterior lobule lies posterior to the urethra and inferior to the ejaculatory ducts.

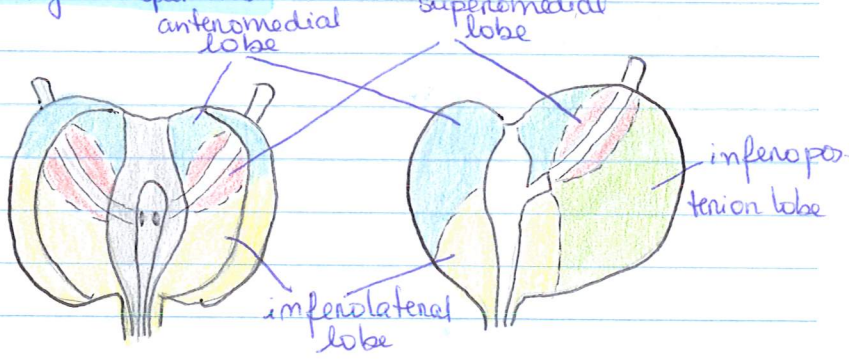
(2) an inferolateral lobule directly lateral to the urethra

(3) a superomedial lobule, deep to the inferoposterior lobule, surrounding the ipsilateral ejaculatory duct

(4) an anteromedial lobe, deep to the inferolateral lobule, directly lateral to the proximal prostatic urethra.

The prostatic ducts (20-30) open chiefly into prostatic sinuses that lie on either side of the seminal colliculus on the posterior wall of the prostatic urethra. Prostatic fluid, a thin, milky fluid, provides approximately 20% of the volume of semen and plays a role in activating the sperms.





35. Male urethra, penis

Most of the approximately 20 cm long male urethra functions as a passage for both urine and semen. The male urethra is subdivided into four parts: intramural (preprostatic), prostatic, intermediate, and spongy. The short initial portion of the male urethra is contained in the wall of the urinary bladder, where it begins at the internal urethral orifice. It continues as the 3,5 cm long prostatic urethra through the prostate. The posterior surface of the inner wall of the prostatic urethra presents a ridge-like projection called the urethral crest. In the middle there is an expansion termed the seminal colliculus. Opening on the lateral sides of the seminal colliculus are the ejaculatory ducts and on its summit a blind-ending sac called the prostatic utricle. Running along either side of the seminal colliculus is a groove called the prostatic sinus.

The intermediate (membranous) part of the urethra begins at the apex of the prostate and traverses the deep perineal pouch, surrounded by the external urethral sphincter. It then penetrates the perineal membrane, ending as the urethra enters the bulb of the penis. Posterolateral to this part of the urethra are the small bulbourethral glands and their slender ducts, which open into the proximal part of the spongy urethra.

The spongy urethra begins at the distal end of the intermediate part of the urethra and ends at the external urethral orifice, which is slightly narrower than any of the other parts of the urethra. The lumen of the spongy urethra is approximately 5 mm in diameter; however, it is expanded in the bulb of the penis to form the intrabulbar fossa and in the glans penis to form the navicular fossa. On each side, the slender ducts of the bulbourethral glands open into the proximal part of the spongy urethra; the orifices of these ducts are extremely small. There are also many minute openings of the ducts of mucus-secreting urethral glands into the spongy urethra.

Penis

The penis is the male copulatory organ and, by conveying the urethra, provides the common outlet for urine and semen. The penis consists of a root, body and glans. It is composed of three cylindrical cavernous bodies of erectile tissue: the paired corpora cavernosa dorsally and the single corpus spongiosum ventrally. In the anatomical position, the penis is erect, when the penis is flaccid, its dorsum is directed anteriorly. Each cavernous body has an outer fibrous covering or capsule, the tunica albuginea. Superficial to the outer covering is the deep fascia of the penis, the continuation of the deep perineal fascia that forms a strong membranous covering for the corpora cavernosa and corpus spongiosum, binding them together

The corpus spongiosum, binding them together. The corpus spongiosum contains the spongy urethra. The corpora cavernosa are fused with each other in the median plane, except posteriorly where they separate to form the crura of the penis. Internally, the cavernous tissue of the corpora is separated by the septum penis.

The root of the penis, the attached part, consists of the crura, bulb, and ischiocavernous and bulbospongiosus muscles. The root is located in the superficial perineal pouch, between the perineal membrane superiorly and the deep perineal fascia inferiorly. The crura and bulb of the penis consist of erectile tissue. Each crus is attached to the inferior part of the internal surface of the corresponding ischial ramus, anterior to the ischial tuberosity. The enlarged posterior part of the bulb of the penis is penetrated superiorly by the urethra, continuing from its intermediate part.

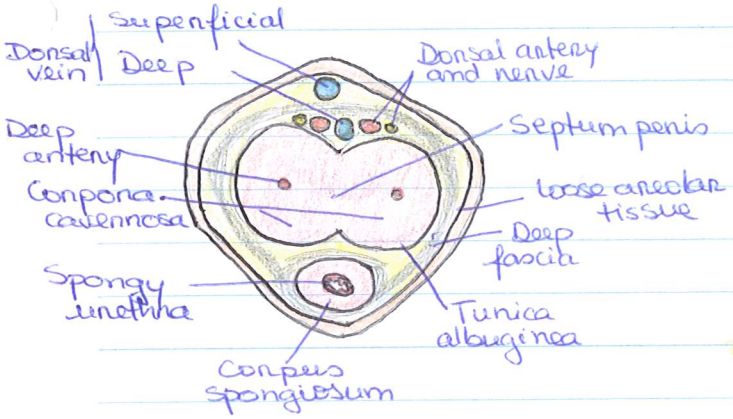
The body of the penis is the free pendulous part that is suspended from the pubic symphysis. Except for a few fibers of the bulbospongiosus near the root of the penis and the ischiocavernous that embrace the crura, the body of the penis has no muscles.

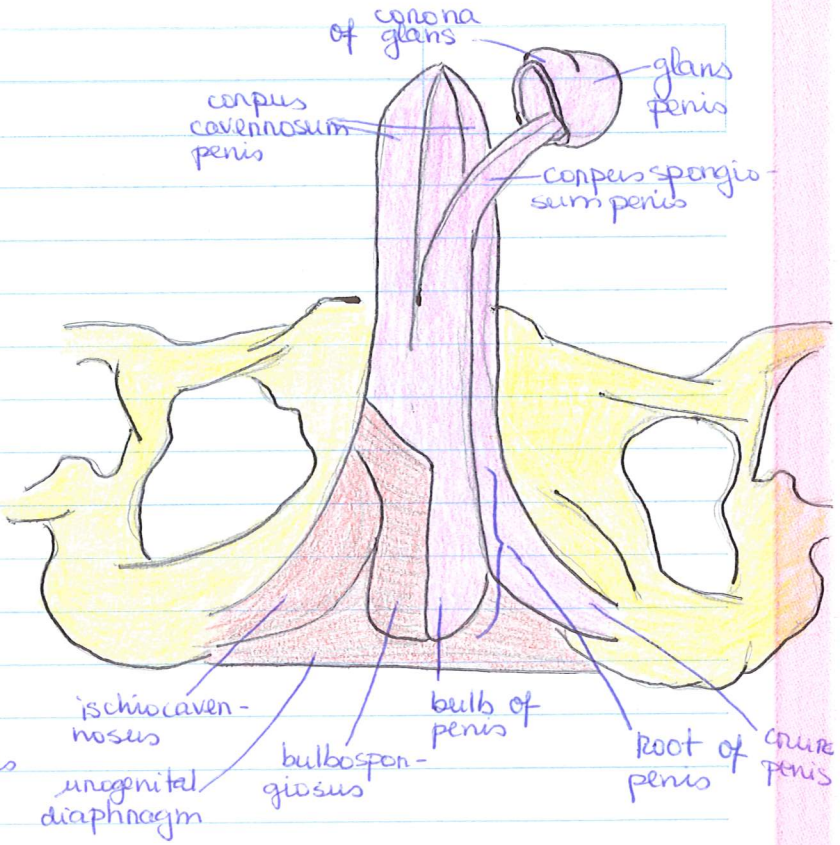
The penis consists of thin skin, connective tissue, blood and lymphatic vessels, fascia, the corpora cavernosa, and corpus spongiosum containing the spongy urethra. Distally, the corpus spongiosum expands to form the conical glans of penis, or head of the penis. The slit-like opening of the spongy urethra, the external urethral orifice (meatus), is near the tip of the glans.

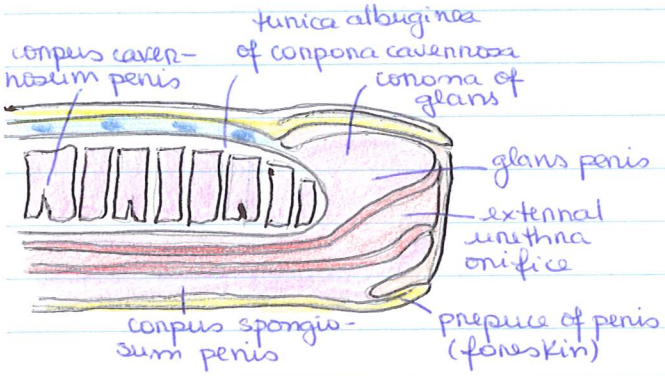
The skin of the penis is thin, darkly pigmented relative to adjacent skin, and connected to the tunica albuginea by loose connective tissue. At the neck of the glans, the skin and fascia of the penis are prolonged as a double layer of skin, the prepuce (foreskin), which in uncircumcised males covers the glans to a variable extent. The frenulum of the prepuce is a median fold that passes from the deep layer of the prepuce to the urethral surface of the glans.

The suspensory ligament of the penis is a condensation of deep fascia that arises from the anterior surface of the pubic symphysis. The ligament passes inferiorly and splits to form a sling that is attached to the deep fascia of the penis at the junction of its root and body.

The fundiform ligament of the penis is an irregular mass or condensation of condensation of collagen and elastic fibers of the subcutaneous tissue that descends in the midline from the linea alba anterior to the pubic symphysis. The ligament splits to surround the penis and then unites and blends inferiorly with the dartos fascia forming the scrotal septum. The fibers of the fundiform ligament are relatively long and loose and lie superficial (anterior) to the suspensory ligament.







36. The external female genital organs

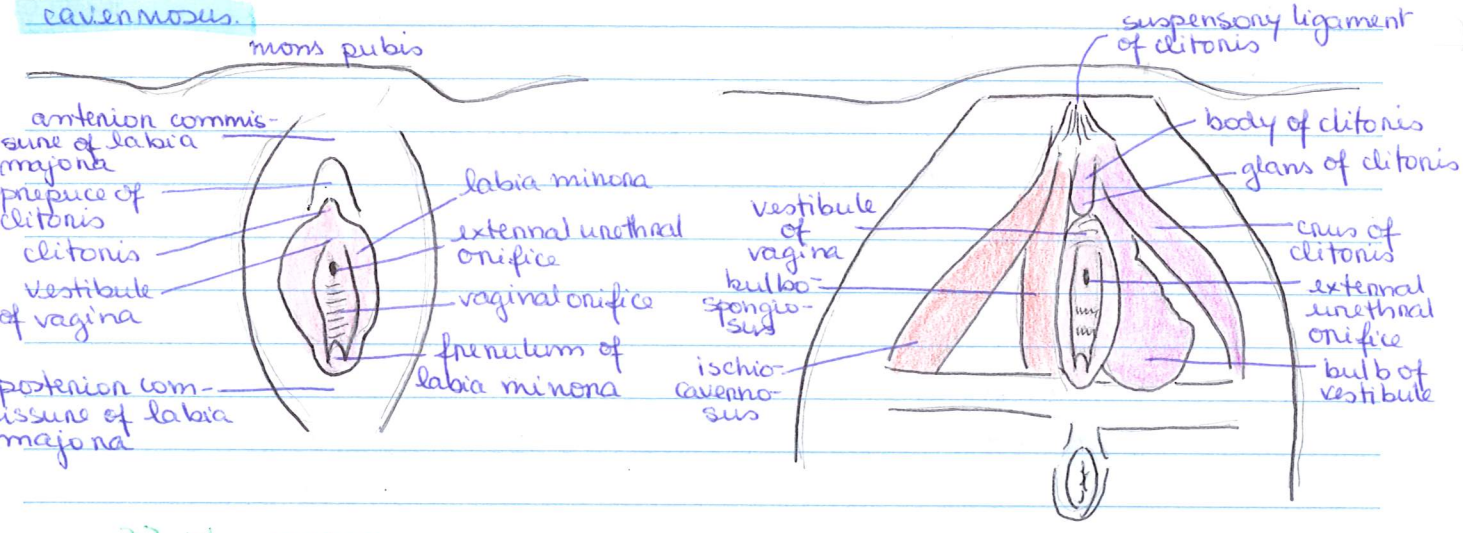
Mons pubis and labia majora - the female external genitalia are located below, on outside of, the pelvic floor. The anterior portion consists of the mons pubis, a skin covered fat pad overlying the pubic symphysis. The pubic air continues caudally onto the labia majori pudendi prominent longitudinal folds that extend from the mons pubis to the perineum and cover the pudendal cleft. They correspond to the scrotum in the male. The labia majora meet anteriorly at the anterior comissure of labia majora and posteriorly at the posterior commonissure of labia majora. Their outer surfaces are lined by pigmented skin containing smooth muscle cells, hair, sebaceous and sweat glands. The epithelium lining their inner surfaces is poorly Konatinized, the skin contains sebaceous glands, but is devoid of hair. The bulb of vestibule is a large venous plexus invested in fascia and covered by the bulbospongiosus. It forms a mass of erectile tissue and corresponds to the corpus spongiosum of the penis in the male. The two bulbs of the vestibule are connected anteriorly by the thin commissure of bulbs.

Labia minora - the labia minora of pudendi folds of skin that are devoid of fat, bound the vestibule of vagina. They are connected posteriorly by the frenulum of labia minora. Anteriorly the labia minora taper into two folds each. the two inner folds form the frenulum of clitoris passing to the clitoris, and the two outer folds unite in front of the clitoris to form the prepuce of clitoris.

Vestibule of vagina - the urethra opens into the anterior portion of the vestibule of vagina via the external urethral orifice, and the vagina opens in the posterior portion

through the vaginal orifice which may be partially closed off by the hymen. On either side of the vaginal orifice, at the termination of each of the vestibular bulbs here, are the bean-sized greater vestibular glands (Bartholin's glands) which open via a 1,5-2 cm long excretory duct into the vestibule of the vagina. The lesser vestibular glands secrete a mucoid discharge.

Clitoris – is an erectile, sensory organ made up of the crus of clitoris, body of clitoris, and glans of clitoris. The bulk of the clitoris is formed by the right and left corpora cavernosa of clitoris which arise from paired crura that are attached to the inferior pubic rami, unite to form the unpaired body of clitoris, and end in the glans of clitoris. In the body of the clitoris the two corpora cavernosa are partially divided by the septum of corpora cavernosa. The clitoris is attached to the inferior border of the pubic symphysis by the suspensory ligament of clitoris. The crura of the corpora cavernosa are covered by the ischio-cavernosus.



37. The vagina

The vagina, a distensible musculomembranous tube (7-9 cm long), extends from the middle cervix of the uterus to the vaginal orifice, the opening at the inferior end of the vagina. The vaginal orifice, external urethral orifice, and ducts of the greater and lesser vestibular glands open into the vestibule of the vagina, the cleft between the labia minora. The superior end of the vagina surrounds the cervix. The vagina:

- serves as a canal for menstrual fluid
- forms the inferior part of the birth canal
- receives the penis and ejaculate during sexual intercourse
- communicates superiorly with the cervical canal and inferiorly with the vestibule of the vagina.

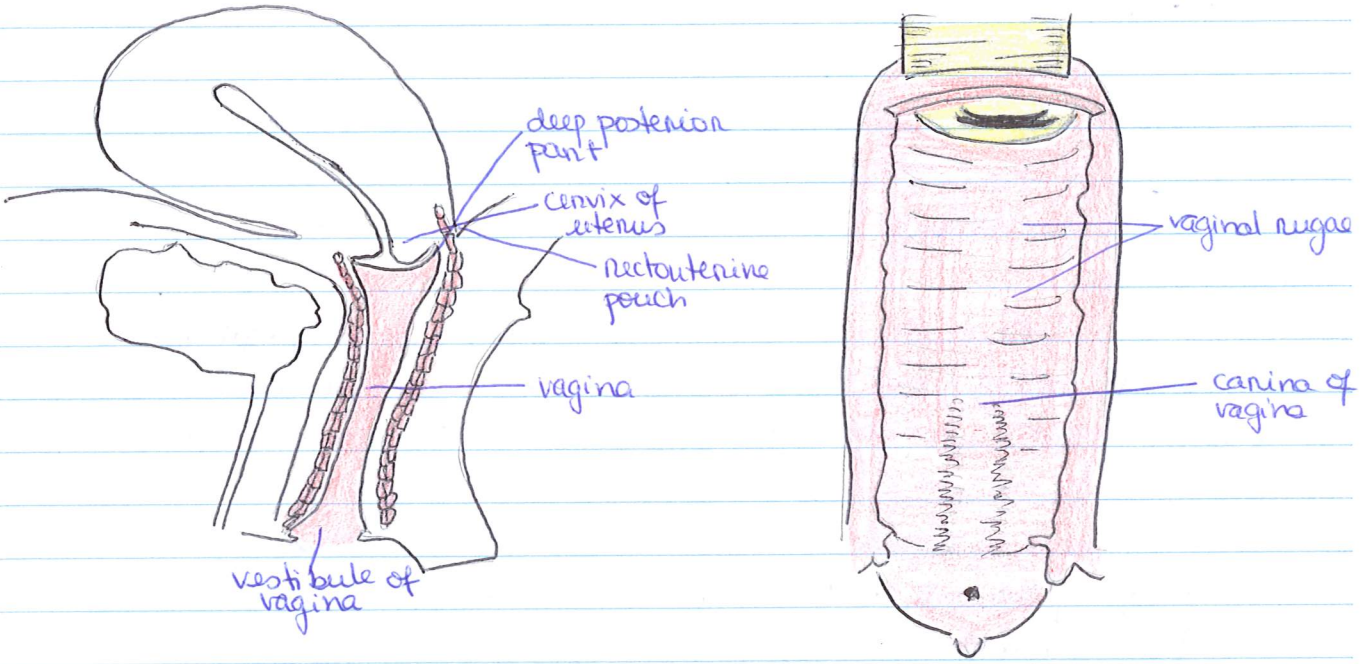
The anterior and posterior walls are in contact on each side of a transverse potential cavity, H-shaped in cross section, except at its superior end where the cervix holds them apart. The vagina lies posterior to the urinary bladder and urethra. It lies anterior to the rectum, passing between the medial margins of the levator ani (puborectalis) muscles. The vaginal fornix, the recess around the cervix, has

anterior, posterior, and lateral parts. The posterior vaginal fornix is the deepest part and is closely related to the rectouterine pouch.

Four muscles compress the vagina and act as sphincters: pubovaginalis, external urethral sphincter, urethrovaginal sphincter, and bulbospongiosus.

The vagina is related:

- anteriorly to the fundus of the urinary bladder and urethra
- laterally to the levator ani, visceral pelvic fascia, and ureters
- posteriorly (from inferior to superior) to the anal canal, rectum, and rectouterine pouch.



The vaginal mucosa contains transverse folds called vaginal rugae as well as longitudinal folds called vaginal columns. The anterior vaginal columns is continuous with the prominent urethral carina of vagina which is produced by the nearby urethra.

38. The uterus

The uterus (womb) is a thick-walled, pear-shaped, hollow muscular organ. The embryo and fetus develop in the uterus. The non-gravid (non-pregnant) uterus usually lies in the lesser pelvis, with its body lying on the urinary bladder and its cervix between the urinary bladder and rectum.

The adult uterus is usually anteverted (tipped anterosuperiorly relative to the axis of the vagina) and anteflexed (flexed or bent anteriorly relative to the cervix, creating the angle of flexion) so that its mass lies over the bladder. The position of the uterus changes with the degree of fullness of the bladder and rectum, and stage of pregnancy. When intra-abdominal pressure is increased, the normally anteverted and anteflexed uterus is pressed against the bladder. However, the uterus may assume

other dispositions, including excessive anteflexion, anteflexion with retroversion, and retroflexion with retroversion. A retroverted uterus will not necessarily prolapse but is more likely to do so.

The non-gravid uterus is approximately 7,5 cm long, 5 cm wide, and 2 cm thick and weighs approximately 90 g. The uterus is divisible into two main parts: the body and cervix.

The body of the uterus, forming the superior two thirds of the organ, includes the fundus of the uterus, the rounded part that lies superior to the uterine ostia. The body lies between the layers of the broad ligament and is freely movable. It has two surfaces: vesical (related to the bladder) and intestinal. The body is demarcated from the cervix by the isthmus of the uterus, a relatively constricted segment, approximately 1 cm long.

The cervix of the uterus is the cylindrical, relatively narrow inferior third of the uterus, approximately 2,5 cm long. For descriptive purposes, two parts are described: the supravaginal part between the isthmus and the vagina, and a vaginal part, which protrudes into the vagina. The rounded vaginal part surrounds the external os of the uterus and is surrounded in turn by a narrow recess, the vaginal fornix.

The slit-like uterine cavity is approximately 6 cm in length from the external os to the wall of the fundus. The uterine horns are the superolateral regions of the uterine cavity, where the uterine tubes enter. The uterine cavity continues inferiorly as the cervical canal. The fusiform canal extends from a narrowing inside the isthmus of the uterine body, the anatomical internal os.

The wall of the body of the uterus consists of three coats or layers:

- Perimetrium - the serosa or outer serous coat - consists of peritoneum supported by a thin layer of connective tissue.
- Myometrium - the middle coat of smooth muscle. The main branches of the blood vessels and nerves of the uterus are located in this coat
- Endometrium - the inner mucous coat - is firmly adhered to the underlying myometrium. The endometrium is actively involved in the menstrual cycle, differing in structure with each stage of the cycle.

The amount of muscular tissue in the cervix is markedly less than in the body of the uterus.

Ligaments of uterus - externally, the ligament of the ovary attaches to the uterus posteroinferior to the uterotubal junction. The round ligament of the uterus attaches anteroinferiorly to this junction.

The broad ligament of the uterus is a double layer of peritoneum (mesentery) that extends from the sides of the uterus to the lateral walls and floor of the pelvis. This ligament assists in keeping the uterus in position. The two layers of the broad ligament are continuous with each other at a free

edge that surrounds the uterine tube. Laterally, the peritoneum of the broad ligament is prolonged superiorly over the vessels as the suspensory ligament of the ovary.

The uterine tube lies in the anterosuperior free border of the broad ligament, within a small mesentery called the mesosalpinx. Similarly, the ovary lies within a small mesentery called the mesovarium on the posterior aspect of the broad ligament. The largest part of the broad ligament, inferior to the mesosalpinx and mesovarium, which serves as a mesentery for the uterus itself, is the mesometrium.

Dynamic support of the uterus is provided by the pelvic diaphragm.

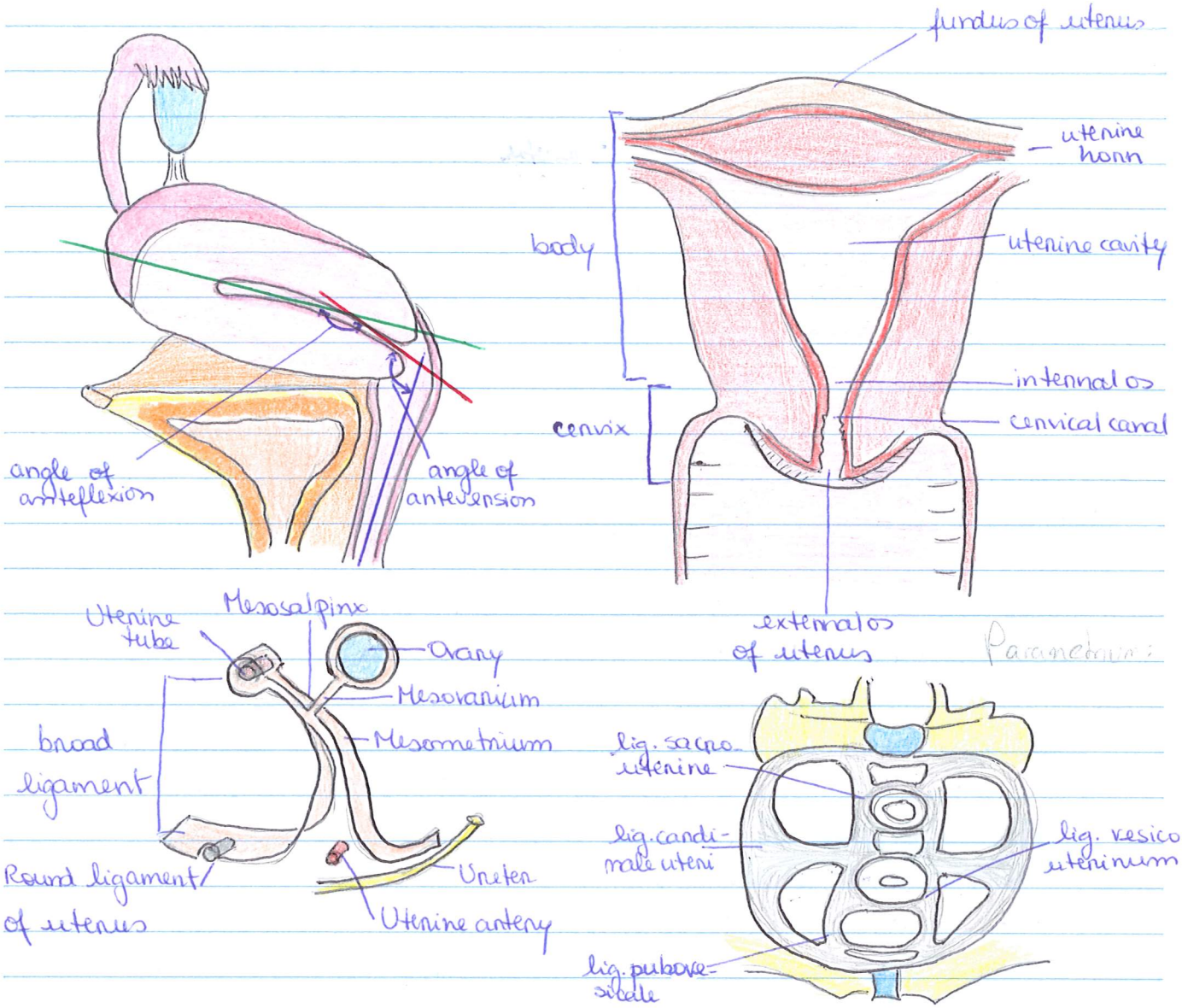
Passive support of the uterus is provided by its position - the way in which the normally anteverted and anteflexed uterus rests on top of the bladder. The cervix is the least mobile part of the uterus because of the passive support provided by attached condensations of endopelvic fascia (ligaments), which may also contain smooth muscle.

- Cardinal (transverse cervical) ligaments extend from the supravaginal cervix and lateral parts of the fornix of the vagina to the lateral walls of the pelvis.
- Uterosacral ligaments pass superiorly and slightly posteriorly from the sides of the cervix to the middle of the sacrum

Relations of Uterus - Peritoneum covers the uterus anteriorly and superiorly, except for the cervix. The peritoneum is reflected anteriorly from the uterus onto the bladder and posteriorly over the posterior part of the fornix of the vagina to the rectum. Anteriorly, the uterine body is separated from the urinary bladder by the vesicouterine pouch. Posteriorly, the uterine body and supravaginal part of the cervix are separated from the sigmoid colon by a layer of peritoneum, and the peritoneal cavity and from the rectum by the rectouterine pouch.

Summary of the relations of the uterus:

- Anteriorly: the vesicouterine pouch and superior surface of the bladder; the supravaginal part of the cervix is related to the bladder and is separated from it by only fibrous connective tissue.
- Posteriorly: the rectouterine pouch containing loops of small intestine and the anterior surface of rectum.
- Laterally: the peritoneal broad ligament flanking the uterine body and the fascial cardinal ligaments on each side of the cervix and vagina.



39. The uterine tube (tuba uterina)

The uterine tubes conduct the oocyte, discharged monthly from an ovary from the periovarian peritoneal cavity to the uterine cavity. They also provide the usual site of fertilization. The tubes extend laterally from the uterine horns and open into the peritoneal cavity near the ovaries.

The uterine tubes (approximately 10 cm long) lie in a narrow mesentery, the mesosalpinx. In the "ideal" disposition, as typically illustrated, the tubes extend symmetrically posterolaterally to the lateral pelvic walls, where they arch anterior and superior to the ovaries in the horizontally disposed broad ligament.

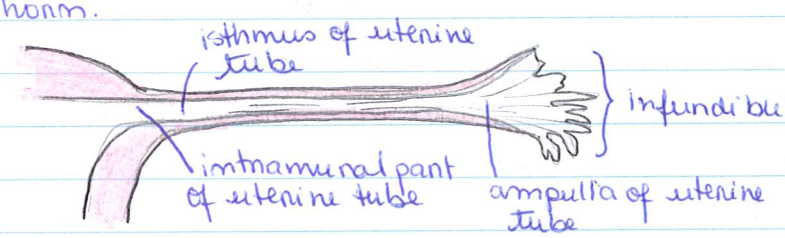
The uterine tubes are divisible into four parts, from lateral to medial:

(1) Infundibulum: the funnel-shaped distal end of the tube that opens into the peritoneal cavity through the abdominal ostium. The finger-like processes of the fimbriated end of the infundibulum (fimbriae) spread over the medial surface of the ovary.

(2) Ampulla: the widest and longest part of the tube, which begins at the medial end of the infundibulum; fertilization of the oocyte usually occurs in the ampulla.

(3) Isthmus: the thick-walled part of the tube, which enters the uterine horn.

(4) Uterine part: the short intramural segment of the tube that passes through the wall of the uterus and opens via the uterine ostium into the uterine cavity at the uterine horn.



40. The ovaries (ovaria)

The ovaries are almond-shaped and -sized female gonads in which the oocytes develop. They are also endocrine glands that produce reproductive hormones. Each ovary is suspended by a short peritoneal fold on mesentery, the mesovarium. The mesovarium is a subdivision of a longer mesentery of the uterus, the broad ligament.

In prepubertal females, the connective tissue capsule (tunica albuginea of the ovary) comprising the surface of the ovary is covered by a smooth layer of ovarian mesothelium or surface (germinal) epithelium.

After puberty, the ovarian surface epithelium becomes progressively scarred and distorted because of the repeated rupture of ovarian follicles and discharge of oocytes during ovulation. The scarring is less in women who have been taking oral contraceptives that inhibit ovulation.

The ovarian vessels, lymphatics, and nerves cross the pelvic brim, passing to and from the superolateral aspect of the ovary within a peritoneal fold, the suspensory ligament of the ovary, which becomes continuous with the mesovarium of the broad ligament. Medially within the mesovarium, a short ovarian ligament tethers the ovary to the uterus. The ovarian ligament is a remnant of the superior part of the ovarian gubernaculum of the fetus. The ligament of the ovary connects the proximal (uterine) end of the ovary to the lateral angles of the uterus, just inferior to the entrance of the uterine tube. Because the ovary is suspended in the peritoneal cavity and its surface is not covered by peritoneum, the oocyte expelled at ovulation passes into the peritoneal cavity.

The cortex of the mature ovary contains ovarian follicles in various stages of development during the menstrual cycle, as well as the corpus luteum and its remnants.

41. The urogenital diaphragm, the muscles of external sex organs

The superficial perineal pouch (compartment) is a potential space between the perineal fascia and the perineal membrane, bounded laterally by the ischiopubic rami.

In males, the superficial perineal pouch contains the:

- Root (bulb and crura) of the penis and associated muscles (ischiocavernosus and bulbospongiosus).
- Proximal (bulbous) part of the spongy urethra
- Superficial transverse perineal muscles
- Deep perineal branches of the internal pudendal vessels and pudendal nerves

In females, the superficial perineal pouch contains the:

- Clitoris and associated muscle (ischiocavernous)
- Bulbs of the vestibule and surrounding muscle (bulbospongiosus)
- Greater vestibular glands
- Superficial transverse perineal muscles.
- Related vessels and nerves (deep perineal branches of the internal pudendal vessels and pudendal vessels).

MUSCLE	ORIGIN	INSERTION	INNERVATION
External anal sphincter	Skin and fascia surrounding anus; coccyx via anococcygeal ligament	Passes around lateral aspects of anal canal, insertion into perineal body	Inferior anal (rectal) nerve, a branch of pudendal nerve (S2-S4)
FUNCTION: constricts anal canal during peristalsis, resisting defecation; supports and fixes perineal body and pelvic floor			
Bulbospongiosus	Male: median raphe on ventral surface of bulb of penis; perineal body	Male: surrounds lateral aspects of bulb of penis and most proximal part of body of penis, inserting into perineal membrane, dorsal aspect of corpus spongiosum and corpora cavernosa, and fascia of bulb of penis	Muscular (deep) branch of perineal nerve, a branch of pudendal nerve (S2-S4)
	Female: perineal body	Female: passes on each side of lower vagina, enclosing bulb and greater vestibular gland; inserts into pubic arch and fascia of corpora cavernosa of clitoris	
FUNCTION: Male → supports and fixes perineal body / pelvic floor; compresses bulb of penis to expel last drops of urine / semen; assists erection by compressing outflow via deep perineal vein and by pushing blood from bulb into body of penis			

FEMALE: supports and fixes perineal body / pelvic floor; "sphincter" of vagina; assists in erection of clitoris (and perhaps bulb of vestibule); compresses greater vestibular gland			
Ischiocavernosus	Internal surface of ischiopubic ramus and ischial tuberosity	Embraces crus of penis or clitoris, inserting onto inferior and medial aspects of crus and to perineal membrane medial to crus	Muscular (deep) branch of perineal nerve, a branch of pudendal nerve (S2-S4)
Superficial transverse perineal muscle		Passes along inferior aspect of posterior border of perineal membrane to perineal body	
Deep transverse perineal muscle		Passes along superior aspect of posterior border of perineal membrane to perineal body and external anal sphincter	
FUNCTION: Ischiocavernosus → maintains erection of penis or clitoris by compressing outflow veins and pushing blood from the root of penis or clitoris into the body of penis or clitoris Transverses → Supports and fixes perineal body / pelvic floor to support abdominopelvic viscera and resist increased intra-abdominal pressure			
External urethra sphincter	Compression urethra portion only	Surrounds urethra superior to perineal membrane; in males, it also ascends anterior aspect of prostate; in females, some fibers also enclose vagina (urethrovaginal sphincter)	Dorsal nerve of penis or clitoris, the terminal branch of the pudendal nerve (S2-S4)

42. The pelvic diaphragm, m. levator ani

Deep perineal pouch

The deep perineal pouch is bounded inferiorly by the perineal membrane, superiorly by the inferior fascia of the pelvic diaphragm, and laterally by the inferior portion of the obturator fascia. It includes the fat-filled anterior recesses of the ischioanal fossae.

In both sexes, the deep perineal pouch contains:

- Part of the urethra, centrally.

- The inferior part of the external urethral sphincter muscle above the center of the perineal membrane, surrounding the urethra
- Anterior extensions of the ischiorectal fat pads.

In males, the deep perineal pouch contains the:

- Intermediate part of the urethra, the narrowest part of the male urethra
- Deep transverse perineal muscles, immediately superior to the perineal membrane (on its superior surface), running transversely along its posterior aspect.
- Bulbourethral glands, embedded within the deep perineal musculature
- Dorsal neurovascular structures of the penis.

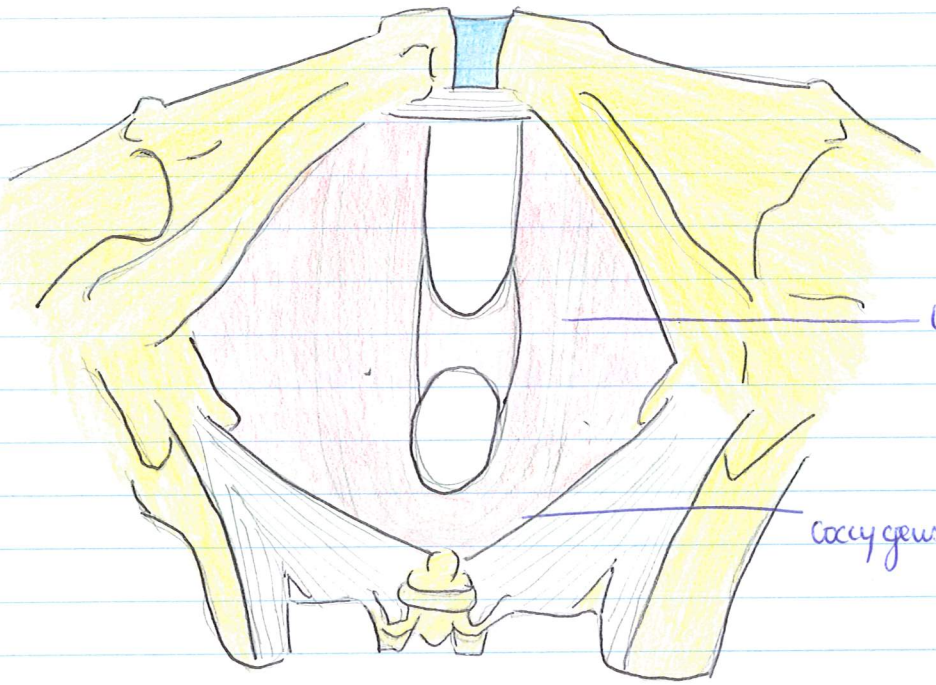
In females, the deep perineal pouch contains the:

- Proximal part of urethra
- A mass of smooth muscle in the place of deep transverse perineal muscles on the posterior edge of the perineal membrane, associated with the perineal body.
- Dorsal neurovasculature of the clitoris

MUSCLE	ORIGIN	INSERTION	INNERVATION
Levator ani	In a line around the pelvic wall beginning on the posterior aspect of the pubic bone and extending across the obturator internus muscle as a tendinous arch (thickening of the obturator internus fascia) to the ischial spine	The anterior part is attached to the superior surface of the perineal membrane; the posterior part meets its partner on the other side at the perineal body, around the anal canal and along the anococcygeal ligament	Branches direct from the ventral rami of S4, and by the inferior rectal branch of the pudendal nerve (S2 to S4)
Coccygeus	Ischial spine and pelvic surface of the sacrospinous ligament	Lateral margin of coccyx and related border of sacrum	Branches from the anterior rami of S3 and S4

FUNCTION: levator ani → contributes to the formation of the pelvic floor, which supports the pelvic viscera; maintains an angle between the rectum and anal canal. Reinforces the external anal sphincter and, in women, functions as a vaginal sphincter

Coccygeus → Contributes to the formation of the pelvic floor, which supports the pelvic viscera; pulls coccyx forward after defecation



43. The con - sunface anatomy

The heart is a double, self-adjusting suction and pressure pump, the parts of which work in unison to propel blood to all parts of the body. The right side of the heart (right heart) receives poorly oxygenated (venous) blood from the body through the SVC and IVC and pumps it through the pulmonary trunk and arteries to the lungs for oxygenation. The left side of the heart (left heart) receives well-oxygenated (arterial) blood from the lungs through the pulmonary veins and pumps it into the aorta for distribution to the body.

The heart has four chambers: right and left atria and right and left ventricles. The atria are receiving chambers that pump blood into the ventricles (the discharging chambers). The synchronous pumping actions of the heart's two atrioventricular (AV) pumps (right and left chambers) constitute the cardiac cycle.

Externally, the atria are demarcated from the ventricles by the coronary sulcus (atrioventricular groove), and the right and left ventricles are demarcated from each other by anterior and posterior interventricular (IV) sulci (grooves). It has an apex (directed anteriorly and to the left), a base (opposite the apex, facing mostly posteriorly), and four sides.

The apex of the heart:

- Is formed by the inferolateral part of the left ventricle
- Lies posterior to the left 5th intercostal space in adults, usually approximately 9 cm (a hand's breadth) from the median plane.
- Remains motionless throughout the cardiac cycle
- Is where the sounds of mitral valve closure are maximal (apex beat); the

apex underlies the site where the heart beat may be auscultated on the thoracic wall.

The base of the heart:

- Is the heart's posterior aspect (opposite the apex)
- Is formed mainly by the left atrium, with a lesser contribution by the right atrium.
- Faces posteriorly toward the bodies of vertebrae T6-T9 and is separated from them by the pericardium, oblique pericardial sinus, esophagus and aorta.
- Extends superiorly to the bifurcation of the pulmonary trunk and inferiorly to the coronary sulcus.
- Receives the pulmonary veins on the right and left sides of its left atrial portion and the superior and inferior venae cavae at the superior and inferior ends of its right atrial portion.

The four surfaces of the heart are the:

1. Anterior (sternocostal) surface, formed mainly by the right ventricle
2. Diaphragmatic (inferior) surface, formed mainly by the left ventricle and partly by the right ventricle; it is related mainly to the central tendon of the diaphragm.
3. Right pulmonary surface, formed mainly by the right atrium
4. Left pulmonary surface, formed mainly by the left ventricle; it forms the cardiac impression in the left lung.

The four borders of the heart are the:

1. Right border (slightly convex), formed by the right atrium and extending between the SVC and the IVC.
2. Inferior border (nearly horizontal), formed mainly by the right ventricle and slightly by the left ventricle.
3. Left border (oblique, nearly vertical), formed mainly by the left ventricle and slightly by the left auricle.
4. Superior border, formed by the right and left atria and auricles in an anterior view; the ascending aorta and pulmonary trunk emerge from this border and the SVC enters its right side. Posterior to the aorta and pulmonary trunk and anterior to the SVC, this border forms the inferior boundary of the transverse pericardial sinus.

44. The atrium cordis dx. et. sin.

RIGHT ATRIUM

The right atrium forms the right border of the heart and receives venous blood from the SVC, IVC, and coronary sinus. The ear-like right auricle is a conical muscular pouch that projects from this chamber like an add-on room, increasing the capacity of the atrium as it overlaps the ascending aorta.

The interior of the right atrium has a:

- Smooth, thin-walled, posterior part (the sinus venarum) on which the venae cavae (SVC and IVC) and coronary sinus open, bringing poorly oxygenated blood into the heart.
- Rough, muscular anterior wall composed of pectinate muscles
- Right AV orifice through which the right atrium discharges the poorly oxygenated blood it has received into the right ventricle.

The smooth and rough parts of the atrial wall are separated externally by a shallow vertical groove, the sulcus terminalis or terminal groove, and internally by a vertical ridge, the crista terminalis or terminal crest. The SVC opens into the superior part of the right atrium at the level of the right 3rd costal cartilage. The IVC opens into the inferior part of the right atrium almost in line with the SVC at approximately the level of the 5th costal cartilage. The opening of the inferior vena cava is shielded by a crescent-shaped valve, the valve of inferior vena cava.

The opening of the coronary sinus, a short venous trunk receiving most of the cardiac veins, is between the right AV orifice and the IVC orifice. The opening of coronary sinus is also shielded by a valvular fold, the valve of coronary sinus. The interatrial septum separating the atrial has an oval, thumbprint-size depression, the oval fossa, which is a remnant of the oval foramen and its valve in the fetus. + limbus ovalis

LEFT ATRIUM

The left atrium forms most of the base of the heart. The valveless pairs of right and left pulmonary veins enter the smooth-walled atrium.

The tubular, muscular left auricle, its wall trabeculated with pectinate muscles, forms the superior part of the left border of the heart and overlaps the root of the pulmonary trunk.

A semilunar depression in the interatrial septum indicates the floor of the oval fossa; the surrounding ridge is the valve of the oval fossa.

The interior of the left atrium has

- A large smooth-walled part and a smaller muscular auricle containing pectinate muscles.
- Four pulmonary veins (two superior and two inferior) entering its smooth posterior wall
- A slightly thicker wall than that of the right atrium
- An interatrial septum that slopes posteriorly and to the right
- A left AV orifice through which the left atrium discharges the oxygenated blood it receives from the pulmonary veins into the left ventricle.

45. The ventriculus cordis dex et sin

RIGHT VENTRICLE

The right ventricle forms the largest part of the anterior surface of the heart, a small part of the diaphragmatic surface, and almost the entire inferior border of the heart.

Superiorly it tapers into an arterial cone, the conus arteriosus (infundibulum), which leads into the pulmonary trunk. The interior of the right ventricle has irregular muscular elevations (trabeculae carneae). A thick muscular ridge, the supraventricular crest, separates the ridged muscular wall of the inflow part of the chamber from the smooth wall of the conus arteriosus, or outflow part. The inflow part of the ventricle receives blood from the right atrium through the right AV (tricuspid) orifice located posterior to the body of the sternum at the level of the 4th and 5th intercostal space.

The tricuspid valve guards the right AV orifice. The bases of the valve cusps are attached to the fibrous ring around the orifice.

Tendinous cords attach to the free edges and ventricular surfaces of the anterior, posterior, and septal cusps. The tendinous cords arise from the apices of papillary muscles, which are conical muscular projections with bases attached to the ventricular wall. The papillary muscles begin to contract before contraction of the right ventricle, tightening the tendinous cords and drawing the cusps together. The cusps of the tricuspid valve are prevented from prolapsing as ventricular pressure rises.

Three papillary muscles in the right ventricle correspond to the cusps of the tricuspid valve:

1. The anterior papillary muscle, the largest and most prominent of the three, arises from the anterior wall of the right ventricle; its tendinous cords attach to the anterior and posterior cusps of the tricuspid valve.
2. The posterior papillary muscle, smaller than the anterior muscle, may consist of several parts; it arises from the inferior wall of the right ventricle, and its tendinous cords attach to the posterior and septal cusps of the tricuspid valve.
3. The septal papillary muscle arises from the interventricular septum, and its tendinous cords attach to the anterior and septal cusps of the tricuspid valve.

The interventricular septum (IVS), composed of muscular and membranous parts, is a strong, obliquely placed partition between the right and left ventricles forming part of the walls of each.

Inferior to the cusp the membrane is an interventricular septum, but superior to the cusp it is an atrioventricular septum, separating the right atrium from the left ventricle.

The septomarginal trabecula is a curved muscular bundle that traverses

the right ventricular chamber from the inferior part of the IVS to the base of the anterior papillary muscle. It carries part of the right branch of the AV bundle to the papillary muscle.

The outflow of blood into the pulmonary trunk (outflow tract) leaves superiorly and to the left. Consequently, the blood takes a U-shaped path through the right ventricle, changing direction about 140°. This change in direction is accommodated by the supraventricular crest, which deflects the incoming flow into the main cavity of the ventricle, and the outgoing flow into the conus arteriosus toward the pulmonary orifice.

The pulmonary valve at the apex of the conus arteriosus is at the level of the left 3rd costal cartilage.

LEFT VENTRICLE

The left ventricle forms the apex of the heart, nearly all its left (pulmonary) surface and border, and most of the diaphragmatic surface.

The interior of the left ventricle has:

- Walls that are two to three times as thick as those of the right ventricle.
- Walls that are mostly covered with a mesh of trabeculae carneae that are finer and more numerous than those of the right ventricle.
- A conical cavity that is longer than that of the right ventricle.
- Anterior and posterior papillary muscles that are longer than those in the right ventricle.
- A smooth-walled, non-muscular, superoanterior outflow part, the aortic vestibule, leading to the aortic orifice and aortic valve.
- A double-leaflet mitral valve that guards the left AV orifice
- An aortic orifice that lies in its right posterosuperior part and is surrounded by a fibrous ring to which the right, posterior, and left cusps of the aortic valve are attached; the ascending aorta begins at the aortic orifice.

The mitral valve has two cusps, anterior and posterior. The mitral valve is located posterior to the sternum at the level of the 4th costal cartilage.

Each of its cusps receives tendinous cords from more than one papillary muscle.

As it traverses the left ventricle, the bloodstream undergoes two right angle turns, which together result in a 180° change in direction.

The semilunar aortic valve, between the left ventricle and the ascending aorta, is obliquely placed. It is located posterior to the left side of the sternum at the level of the 3rd intercostal space

46. The myocardium and conductive system of the heart

Myocardium

The atrial myocardium can be divided into superficial and deep layers. The superficial layer extends over both atria and is thicker along its anterior aspect than its posterior aspect.

The fibers of the right ventricle run nearly horizontally around the surface, while those of the left ventricle are directed almost longitudinally toward the diaphragmatic surface. At the apex of the two ventricles the superficial subepicardial muscle fibers form the vortex of the heart.

Stimulating and Conducting System of the Heart

The conducting system of the heart generates and transmits the impulses that produce the coordinated contractions of the cardiac cycle. The conducting system consists of modal tissue that initiates the heartbeat and coordinates contractions of the four heart chambers, and highly specialized conducting fibers for conducting them rapidly to the different areas of the heart. The impulses are then propagated by the cardiac striated muscle cells so that the chamber walls contract simultaneously.

The sinuatrial (SA) node is located anterolaterally just deep to the epicardium at the junction of the superior vena cava and right atrium, near the superior end of the sulcus terminalis. The SA node - a small collection of modal tissue, specialized cardiac muscle fibers, and associated fibroelastic connective tissue - is the pacemaker of the heart. The SA node initiates and regulates the impulses for the contractions of the heart, giving off an impulse approximately 70 times per minute in most people most of the time.

The atrioventricular (AV) node is a smaller collection of nodal tissue than the SA node. The AV node is located in the posteroinferior region of the interatrial septum near the opening of the coronary sinus. The signal generated by the SA node passes through the walls of the right atrium, propagated by the cardiac muscle (myogenic conduction), which transmits the signal rapidly from the SA node to the AV node. The AV node then distributes the signal to the ventricle to the ventricles through the AV bundle. The AV bundle, the only bridge between the atrial and ventricular myocardium, passes from the AV node through the fibrous skeleton of the heart and along the membranous part of the interventricular septum.

At the junction of the membranous and muscular parts of the IVS, the AV bundle divides into right and left bundles. These branches proceed on each side of the muscular IVS deep to the endocardium and the ramify into subendocardial branches (Purkinje fibers), which extend into the walls of the respective ventricles. The subendocardial branches of the right bundle stimulate the muscle of the IVS, the anterior papillary muscle through the septomarginal trabecula and the wall of the right ventricle. The left bundle divides near its origin into approximately six smaller tracts, which give rise to subendocardial branches that stimulate the IVS, the anterior and posterior

papillary muscles, and the wall of the left ventricle.

Impulse generation and conduction can be summarized as follows:

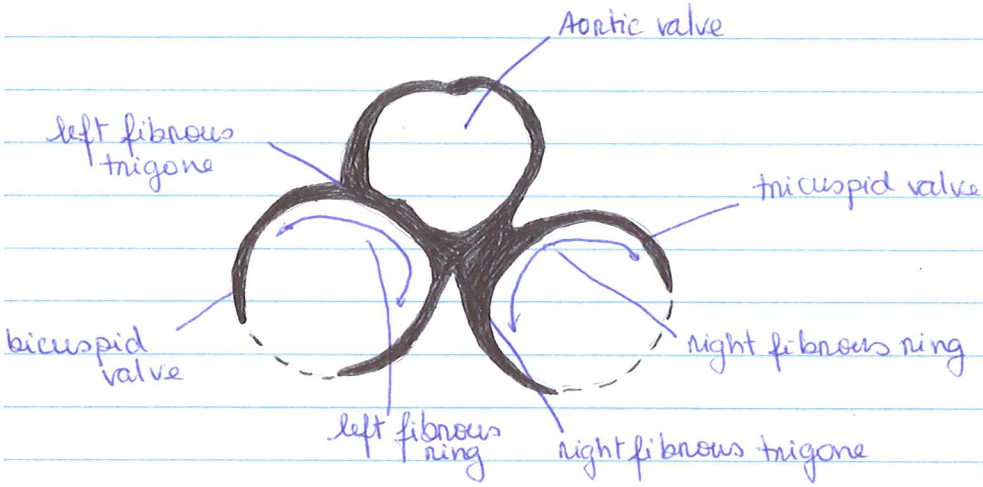
- The SA node initiates an impulse that is rapidly conducted to cardiac muscle fibers in the atria, causing them to contract
- The impulse spreads by myogenic conduction, which rapidly transmits the impulse from the SA node to the AV node.
- The signal is distributed from the AV node throughout the AV bundle and its branches (the right and left bundles), which pass on each side of the IVS to supply subendocardial branches to the papillary muscles and the walls of the ventricles

47. The endocardium and heart skeleton

The muscle fibers are anchored to the fibrous skeleton of the heart. This is a complex framework of dense collagen forming four fibrous rings that surround the orifices of the valves, a right and left fibrous trigone (formed by connections between rings), and the membranous parts of the interatrial and interventricular septa. The fibrous skeleton of the heart:

- Keeps the orifices of the AV and semilunar valves patent and prevents them from being overly distended by an increased volume of blood pumping through them
- Provides attachments for the leaflets and cusps of the valves
- Provides attachment for the myocardium, which, when uncoiled, forms a continuous ventricular myocardial band that originates primarily from the fibrous ring of the pulmonary valve and inserts primarily into the fibrous ring of the aortic valve.
- Forms an electrical "insulator", by separating the myogenically conducted impulses of the atria and ventricles so that they contract independently and by surrounding and providing passage for the initial part of the AV bundle of the conducting system of the heart.

The cardiac skeleton separates the muscle of the atria and ventricles. The thickest area of condensed connective tissue is found at the site where the aortic valve, tricuspid valve, and bicuspid valve meet. This area is known as the right fibrous trigone on central fibrous body. The site where the aortic and bicuspid valves meet is referred to as the left fibrous trigone. The orifices of the tricuspid valve and bicuspid valve are surrounded by two incomplete fibrous rings, the right fibrous ring and left fibrous ring, which serve for the attachment of the valve flaps. The pulmonary valve is not anchored at all to the cardiac skeleton.



ENDOCARDIUM

The inner surface of the myocardium is lined with endocardium, a continuation of the inner layer of the vessel walls consisting of an endothelial layer and a thin layer of connective tissue.

43. The arteries and veins of the heart

The main stems of the right coronary artery and left coronary artery arise in the aortic sinuses of the right and left semilunar valves. → Ascending AORTA

- RIGHT CORONARY ARTERY (RCA) - arises from the right aortic sinus of the ascending aorta and passes to the right side of the pulmonary trunk, running in the coronary sulcus. Near its origin, the RCA usually gives off an ascending sinuatrial nodal branch, which supplies the SA node. The RCA then descends in the coronary sulcus and gives off the right marginal branch, which supplies the right border of the heart as it runs toward (but does not reach) the apex of the heart. After giving off this branch, the RCA turns to the left and continues in the coronary sulcus to the posterior aspect of the heart. At the posterior aspect of the crux of the heart the RCA gives rise to the atrioventricular nodal branch, which supplies the AV node.

Dominance of the coronary arterial system is defined by which artery gives rise to the posterior interventricular (IV) branch (posterior descending artery). Dominance of the right coronary artery is typical (approximately 67%); the right coronary artery gives rise to the large posterior interventricular branch, which descends in the posterior IV groove toward the apex of the heart. It sends perforating interventricular septal branches into the IV septum. The terminal (left ventricular) branch of the RCA then continues for a short distance in the coronary sulcus.

Typically, the RCA supplies:

- The right atrium
- Most of right ventricle
- Part of the left ventricle (the diaphragmatic surface).
- Part of the IV septum, usually the posterior third
- The SA node
- The AV node

- LEFT CORONARY ARTERY (LCA) - arises from the left aortic sinus of the ascending aorta, passes between the left auricle and the left side of the pulmonary trunk, and runs in the coronary sulcus. As it enters the coronary sulcus, at the superior end of the anterior IV groove, the LCA divides into two branches, the anterior IV branch and the circumflex branch.

The anterior IV branch passes along the IV groove to the apex of the heart. Here it turns around the inferior border of the heart and commonly anastomoses with the posterior IV branch of the right coronary artery.

In many people, the anterior IV branch gives rise to a lateral branch, which descends on the anterior surface of the heart.

The smaller circumflex branch of the LCA follows the coronary sulcus around the left border of the heart to the posterior surface of the heart. The left marginal branch of the circumflex branch follows the left margin of the heart and supplies the left ventricle.

Typically, the LCA supplies:

- The left atrium
- Most of the left ventricle
- Part of the right ventricle
- Most of the IVS (usually its anterior two-thirds)
- The SA node

- Coronary Collateral Circulation

Anastomoses exist between branches of the coronary arteries, subepicardial or myocardial, and between these arteries and extracardiac vessels such as thoracic vessels. The potential for development of collateral circulation probably exists in most if not all hearts.

- VENOUS DRAINAGE OF THE HEART

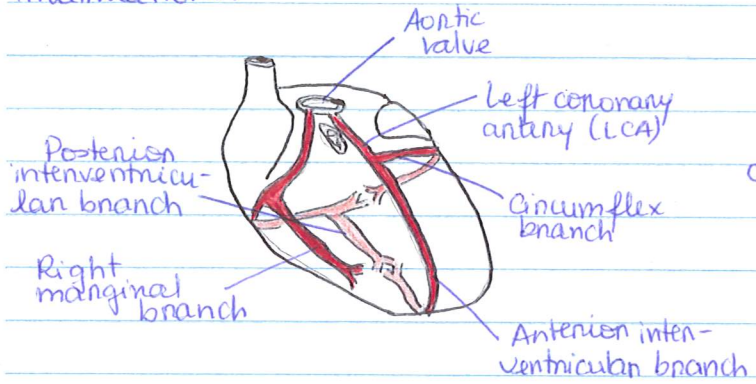
The heart is drained mainly by veins that empty into the coronary sinus and partly by small veins that empty into the right atrium. The coronary sinus receives the great cardiac vein at its left end and the middle cardiac vein and small cardiac veins at its right end. The left posterior ventricular vein and left marginal vein also open into the coronary sinus.

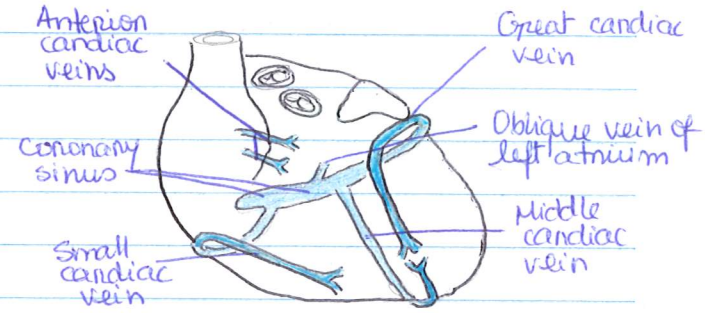
The great cardiac vein is the main tributary of the coronary sinus. Its first part, the anterior interventricular vein, begins near the apex of the heart and ascends with the anterior IV branch of the LCA. At the coronary sulcus it turns left to reach the coronary sinus. The great cardiac veins drains the areas of the heart supplied by the LCA.

The middle cardiac vein (posterior IV vein) accompanies the posterior interventricu-

lar branch (usually arising from the RCA). A small cardiac vein accompanies the right marginal branch of the RCA. Thus these two veins drain most of the areas commonly supplied by the RCA.

Some cardiac veins do not drain via the coronary sinus. Several small anterior cardiac veins begin over the anterior surface of the right ventricle, cross over the coronary sulcus, and usually end directly in the right atrium; sometimes they enter the small cardiac vein. The smallest cardiac veins, although called veins, they are valveless communications.





49. The aorta and aa. and vv. pulmonales (+54, +55, +56)

AORTA

The aorta arises from the left ventricle of the heart and initially ascends behind the pulmonary trunk to the right. The ascending aorta then curves to form the aortic arch, continues posteriorly over the root of the left lung and, after reaching the level of T4, descends on the left side of the anterior aspect of the vertebral column as the descending aorta.

- Ascending aorta - this gives rise to the right and left coronary arteries as the first branches of the aorta. (3-5 cm)

- Aortic arch - gives rise to the great vessels supplying the head, neck and arms. The first branch arises on the right side as the 2-3 cm long brachiocephalic trunk. It ascends obliquely to the right over the trachea and divides into the right subclavian artery and right common carotid artery. Along the left side of the mediastinum the left common carotid artery and left subclavian artery emerge from the aortic arch.

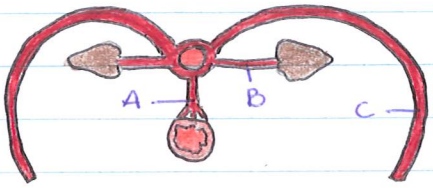
- Descending aorta - distal to the origin of the left subclavian artery, the aorta tapers slightly to become the aortic isthmus, forming the junction with the descending aorta. The descending aorta can be divided into the thoracic aorta which extends as far as the aortic hiatus of the diaphragm and extends as far as the aortic bifurcation at the level of L4.

♦ THORACIC AORTA

It begins on the left side of the inferior border of the body of T4 vertebra and descends in the posterior mediastinum on the left sides of the T5-T12 vertebrae. The thoracic aorta lies posterior to the root of the left lung, pericardium, and esophagus.

The branches of the descending aorta arise and course within three "vascular

planes":



- An anterior, midline plane of unpaired visceral branches to the gut and its derivatives (A)
- Lateral planes of paired visceral branches serving viscera other than the gut and its derivatives (B)
- Posterolateral planes of paired (segmental) parietal branches to the body wall (C)

The paired parietal branches of the thoracic aorta that arise posterolaterally are the nine posterior intercostal arteries that supply the 3rd to 11th intercostal spaces through sulcus costae, first between mm intercostales externi and interni, then between mm. intercostales interni and intimi. They anastomose with nn. intercostales anteriores from a. thoracica interna and a. musculophrenica respectively. The lowermost a. subcostalis runs below the 12th rib.

→ Branches:

- R. dorsalis – nn musculares for muscles of the back
  - R. spinalis
  - nn. cutanei med. et. lat. for the skin of the back
- nn. musculares for the thoracic muscles
- R. collateralis arising at the angulus costae and running at the upper mangin of the lower rib
- R. cutaneus lat. for the skin of the thorax – nn. mammarii lat.

Also the superior phrenic arteries are paired parietal branches that pass anterolaterally to the superior surface of the diaphragm.

The unpaired visceral branches of the anterior vascular plane are the esophageal arteries (6–9). The paired visceral branches of the lateral plane are represented in the thorax by the bronchial arteries.

The pericardial branches are also unpaired branches that arise anteriorly but instead of passing to the gut, send twigs to the pericardium. The same is true for the small mediastinal arteries that supply the lymph nodes and other tissues of the posterior mediastinum.

♦ ABDOMINAL AORTA retroperitoneal

The abdominal aorta descends anterior to the bodies of the T12–L4 vertebrae. The left lumbar veins pass posterior to the aorta to reach the IVC. On the right, the aorta is related to the azygos vein, cisterna chyli, thoracic duct, right crus of the diaphragm, and right celiac ganglion. On the left, the aorta is related to the left crus of the diaphragm and the left celiac ganglion.

The branches of the descending aorta may be described as arising and coursing in three "vascular planes". Paired parietal branches of the aorta serve the diaphragm and posterior abdominal wall.

Parietal branches are paired:

1. A. phrenica inferior - inferior surface of the diaphragm → a. suprarenalis sup.
2. Aa. lumbales - 4 paired branches that run laterally behind m. psoas major → R. dorsalis; → R. spinalis

Paired visceral branches:

1. A. suprarenalis media
2. A. renalis - L1/L2
   - R. uretericus
   - a. suprarenalis inf.
   - RR. praepelvici - 4
   - R. retropelvicus - 1

   ] for 5 kidney segments

NOTE: Aa. renales accessoriae often arise from aorta that may enter the kidney at any site of renal surface → COMPLICATIONS FOR KIDNEY SURGERY

3. a) A. testicularis - L2, over the common or external iliac, spermatic cord - supplies the testis and epididymis → RR. ureterici

   b) A. ovarica - to the ovary through the lig. suspensorium ovarii, anastomoses with R. ovaricus a. uterinae → R. ureterici; R. tubarius

Unpaired visceral branches:

1. Tr. coeliacus - 1-2 cm, T12/L1

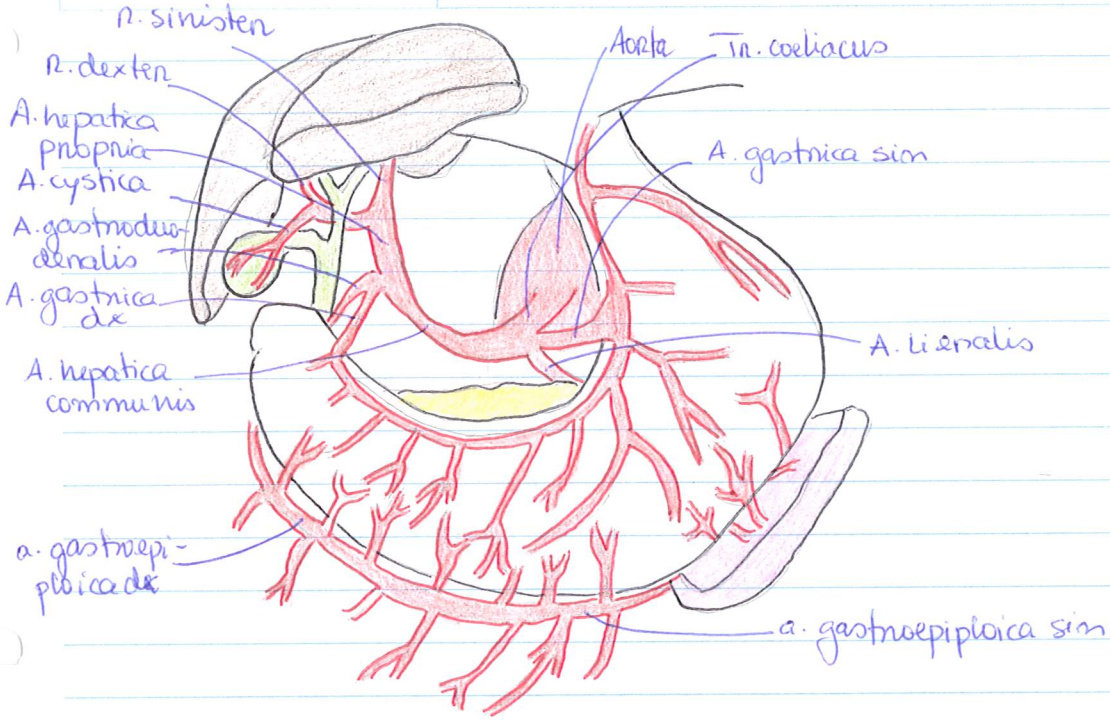
   a) a. gastrica sin. - along the lesser curvature of the stomach, anastomoses with a. gastrica dx (from a. hepatica propria) → RR. oesophagei

   b) a. hepatica communis - behind the pylorus:

   • a. hepatica propria - lig. hepatoduodenale - porta hepatis + b. c. duct
     - a. gastrica dx - lesser curvature
     - R. dexter (a. cystica) et sinister

   • a. gastroduodenalis - descends behind of the pylorus
     - a. gastroepiploica dx - along the greater curvature, anastomoses with a. gastroepiploica sin (a. lienalis).
     - a. pancreatoduodenalis sup. - between the head of the pancreas and the descending part of the duodenum, anastomoses with a. pancreatoduodenalis inf (from a. mesenterica sup.)

   c) a. lienalis - along the upper margin of the pancreas
   - RR. pancreatici
   - a. gastroepiploica sin - greater curvature of the stomach
   - aa. gastricae breves - fundus ventriculi
   - RR. lienalis



2. A. mesenterica sup. (L1) enters the mesentery - right iliac fossa, supplies the intestine from the caudal part of the duodenum to the left colic flexure

- a. pancreaticoduodenalis inf.
- aa. jejunales et ilei (10-13) - 1-2 arcades at the jejunum (longer), 3-4 arcades at ileum (shorter).
- a. ileocolica - R. ileus
  - R. colicus
  - R. appendicularis
- a. colica dx - ascending colon
- a. colica media - enters the transverse mesocolon, supplies the transverse colon

3. A. mesenterica inf. (L2/3)

- a. colica sin. - descending colon
- aa. sigmoideae
- a. rectalis sup. - anastomoses with the sigmoidal arteries and a. rectalis media

Terminal branches:

1. A. sacralis mediana - an unpaired parietal branch may be said to occupy a fourth plane because it arises from the posterior aspect of the aorta just proximal to its bifurcation. - arteriovenosus anastomosis (glomus coccygeum) - v. sacralis mediana
- a. lumbalis ima laterally
- RR. sacrales anastomose with the lateral sacral arteries (a. iliaca int)

2. A. iliaca communis dx et sin - bifurcatio aortae - to the anticulatio sacroiliaca, the right artery is longer than the left one, the ureter and testicular (ovarian) vessels cross common iliac vessels anteriorly.

- a. iliaca interna
- a. iliaca externa

PULMONARY TRUNK

The pulmonary trunk, approximately 5 cm long and 3 cm wide, is the arterial continuation of the right ventricle and divides into right and left pulmonary arteries. The pulmonary trunk and arteries conduct low-oxygen blood to the lungs for oxygenation.

The right and left pulmonary arteries arise from pulmonary trunk at the level of the sternal angle. Each pulmonary artery becomes part of the root of the corresponding lung and divides secondary lobar arteries. The right and left superior lobar arteries to the superior lobes arise first, before entering the hilum. Continuing into the lung, the artery descends posterolateral to the main bronchus as the inferior lobar artery of the left lung and as an intermediate artery that will divide into middle and inferior lobar arteries of the right lung. Lobar arteries divide into tertiary segmental arteries. The arteries are usually located on the anterior aspect of the corresponding bronchus.

50. A. carotis communis, a. carotis ext.

The right common carotid artery, originates from the brachiocephalic trunk and the left common carotid artery, arises directly from the aortic arch and that's why the left is 4 cm longer than the right one. They ascend along either side of the trachea and larynx, posterior to m. sternocleidomastoideus and m. omohyoideus, medial to the v. jugularis interna and n. vagus. About midway along the neurovascular bundle, the common carotid artery passes to a nonmuscular triangle known as the carotid triangle, where it is covered only by skin, platysma and superficial cervical fascia. At the level of C4 the common carotid artery divides into the external carotid artery and the internal carotid artery. The bifurcation of the common carotid artery is dilated to form the carotid sinus, which has numerous receptors that monitor changes in blood pressure. The internal carotid artery ascends to the interior of the cranium without giving off any branches. The external carotid artery distributes branches to the neck, face and head.

A. CAROTIS EXTERNA

It supplies the upper half of the neck and the head except the brain, orbit and inner ear. It runs medially to the m. stylohyoideus and enters posterior m. digastrici, submandibular triangle and fossa retromandibularis. In the parotid gland it is crossed by the v. facialis, v. lingualis, vv. thyroideae sup. and n. hypoglossus. It goes lateral to the pharynx, anterior to the styloid septum.

Ventral branches:

1. A. thyroidea sup:
   a) R. infrahyoideus
   b) n. sternocleidomastoideus
   c) a. laryngea sup.
   d) R. cricothyroideus
   e) R. anterior et posterior
2. A. lingualis
   a) R. suprahyoideus
   b) a. sublingualis
   c) rr. dorsales linguae
   d) a. profunda linguae
3. A. facialis
   a) a. palatina ascendens
   b) R. tonsillaris - tonsilla palatina
   c) a. submentalis
   d) rr. glandulares - glandula submandibularis
   e) a. labialis inf. et sup. - arcus labialis sup. and inf. - circulus arteriosus oris
   f) a. alaris nasi
   g) a. angularis anastomoses with a. ophtalmica and a. infraorbitalis

Lateral branch:

1. A. sternocleidomastoidea - arcus n. hypoglossi runs below the artery

Dorsal branches:

1. A. occipitalis:
   a) rr. musculares (a. sternocleidomastoidea)
   b) n. mastoideus - foramen mastoideum - cranial cavity
   c) R. auricularis - medial surface of the auricle
   d) rr. occipitales - terminal branches
2. A. auricularis post.:
   a) rr. musculares
   b) rr. glandulares - parotid gland
   c) n. auricularis - auricle
   d) a. stylomastoidea - it goes inside the cranium through the foramen stylomastoidea and then through canalis facialis → a. tympanica post. to the tympanic cavity; → rr. mastoidei to cellulae mastoideae; → R. stapedialis to m. stapedius
   e) R. occipitalis

Medial branch:

1. A. pharyngea ascendens:
   a) nn. pharyngeales
   b) a. tympanica inf. - canaliculus tympanicus - tympanic cavity
   c) a. meningea post. - foramen jugulare → posterion cranial fossa → duna mater

Terminal branches:

1. A. temporalis spf:
   a) nn. parotidei
   b) a. transversa faciei
   c) a. zygomaticoorbitalis
   d) nn. auriculares ant. - mandibular joint, meatus acusticus ext., lateral side of the auricle
   e) a. temporalis media - m. temporalis
   f) n. frontalis et r. parietalis

2. A. maxillaris - medial to the collum mandibulae (pars mandibularis), fossa infratemporalis (pars pterygoidea), fossa pterygopalatina (pars pterygopalatina)

♦ PARS MANDIBULARIS

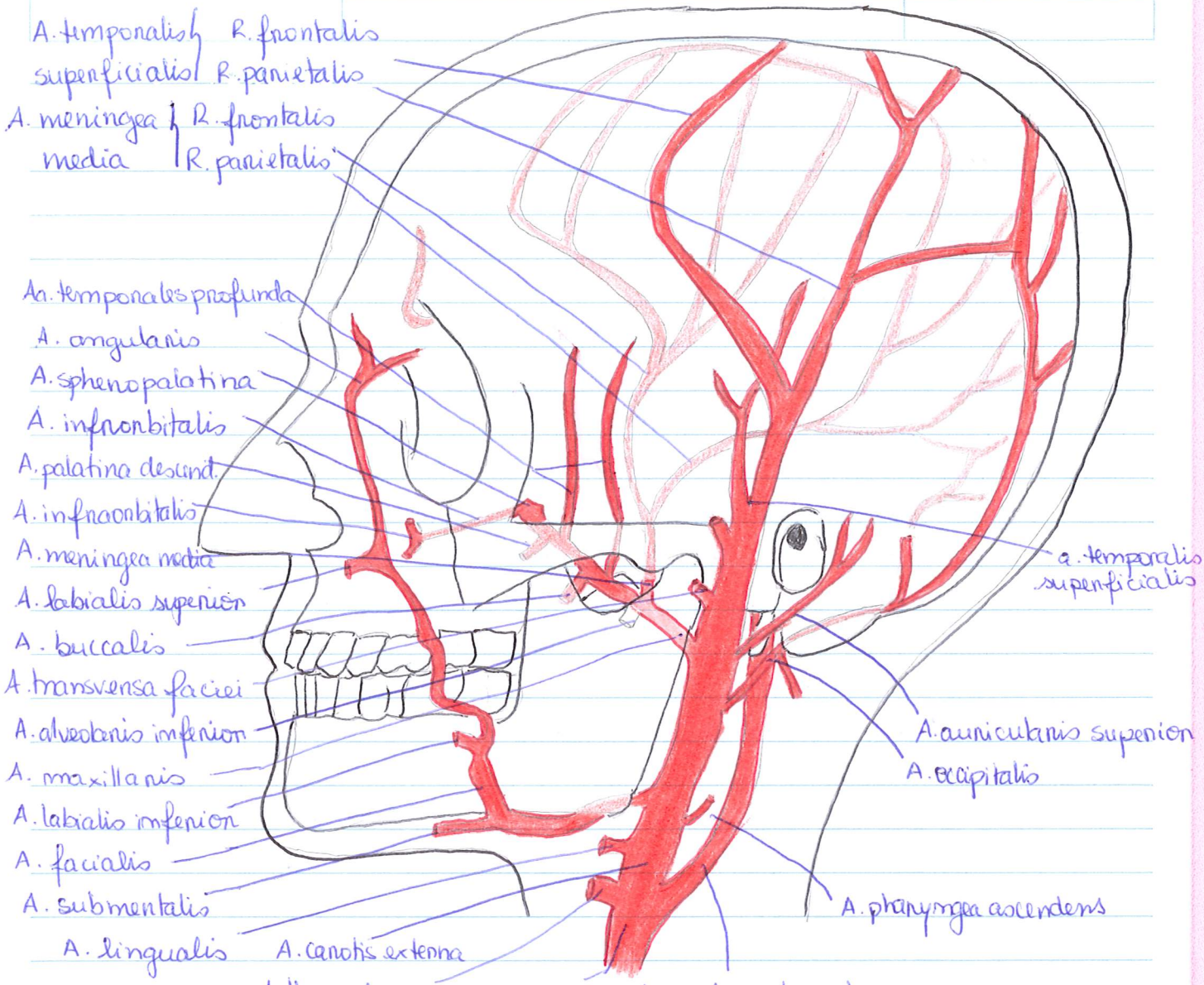
a) a. auricularis prof. - meatus acusticus ext.
b) a. tympanica ant. - fissura petrotympanica - tympanic cavity
c) a. meningea media - goes through foramen spinosum to middle cranial fossa → r. frontalis; → r. parietalis; → r. orbitalis; → a. tympanica sup → goes through canalis facialis to tympanic cavity
d) a. alveolaris inf. - r. mylohyoideus goes through canalis mandibulae → nn. dentales; → nn gengivales; → a. mentale which comes out from foramen mentale

♦ PARS PTERYGOIDEA (muscular):

a) a. masseterica
b) aa. temporalis prof.
c) nn. pterygoidei
d) a. buccalis

♦ PARS PTERYGOPALATINA

a) a. infraorbitalis - goes through fissura orbitalis inferior, sulcus and canalis infraorbitalis and goes out from foramen infraorbitale → aa. alveolares sup. anteriores (nn. dentales and gingivales) - upper premolars, canine, incisors
b) a. alveolaris sup post - goes from foramen alveolaria (tuber maxillae) - nn. dentales and gingivales - upper molars.
c) a. palatina descendens - a. palatina major, aa. palatinae minores
d) a. canalis pterygoidei - nasal part of the pharynx
e) a. sphenopalatina - goes through foramen sphenopalatinum - nasal cavity → aa. nasales post. lat. et med. (septi).



51. A. subclavia

On the right side, the subclavian artery arises from the brachiocephalic trunk and on the left directly from the aortic arch. It can be divided into three parts based on its relation to the anterior scalene muscle: the first portion, where it leaves an impression on the apex of the lung; the second portion lies posterior to the muscle in fissura scalenorum; and the third portion extends from the lateral margin of the anterior scalene to the inferior border of the first rib. From that point onward it is known as the axillary artery.

1. A. vertebralis

It goes up through foramen transversarium C6 and all foramina transversaria of upper cervical vertebrae till the base of the skull. It passes on the sulcus a. subclaviae atlantis and up to foramen magnum.

Through cervical vertebrae it gives off rr. spinales for the spinal cord and meninges; rr. musculares for deep cervical muscles.

Its intracranial branches: R. meningeus - posterior cranial fossa
a. spinalis post. - sulcus lat. post. of the spinal cord
a. spinalis ant - fissura mediana ant. of the spinal cord

2. A. thoracica interna

It starts 1 cm from the border of the sternum to the level of the 6th and 7th costal cartilages.

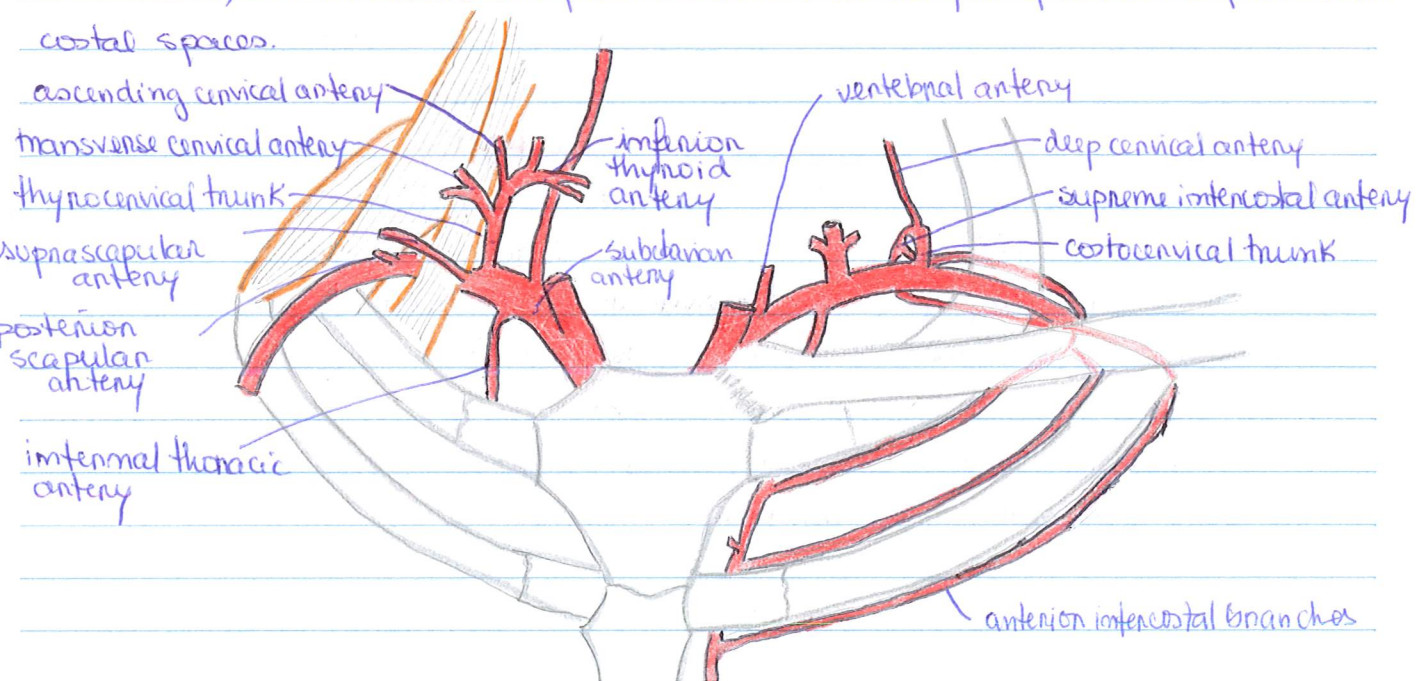
a) Viscenal - nn. mediastinales, thymici, bronchiales
b) A. pericardiophrenica
c) Rn. sternales
d) Rn. perforantes - nn. mammarii
e) Rn. intercostales anteriores - 6 cranial intercostal spaces - anastomose with aa. intercostales posteriones
f) A. musculophrenica - at the circumference of the diaphragm - nn. intercostales ant. for 5 caudal intercostal spaces
g) A. epigastrica sup. - posterior surface of the m. rectus abdominis - anastomoses with the a. epigastrica inf. (a. iliaca ext.).

3. Truncus thyrocervicalis

a) A. thyroidea inf. - toward the thyroid gland - A. laryngea inf., nn. pharyngei, nn. oesophagei, nn. thymici, nn. tracheales
b) A. cervicalis ascendens - along the anterior side of the m. scalenus ant.
c) A. cervicalis sup. - m. trapezius (may be a branch of a. transversa colli)
d) A. suprascapularis - margo superior scapulae scapulae (over transverse ligament) to fossa supraspinata and infraspinata - anastomoses with the a. circumflexa scapulae (a. subscapularis)

4. Truncus costocervicalis

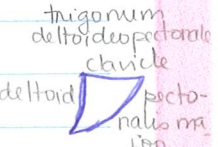
a) A. cervicalis profunda - nuchal muscles (runs between m. spinalis capitis and cervicis).
b) A. intercostalis suprema - aa. intercostales post. for the two first intercostal spaces.



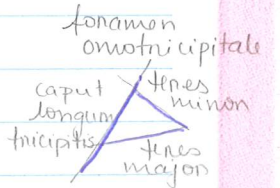
52. A. axillaris et brachialis

The axillary artery passes as the continuation of the subclavian artery from the inferior border of the first rib to the inferior border of the pectoralis major on tendon of the latissimus dorsi. It is covered on its anterior side by the pectoralis minor and pectoralis minor.

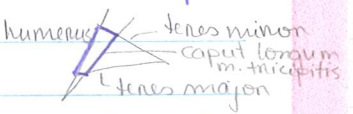
1. Rr. subscapulares - mm. subscapularis
2. A. thoracica suprema - mm. pectorales
3. A. thoracoacromialis - runs in the trigonum deltoideopectorale - R. acromialis → rete acromiale; R. deltoideus → mm. deltoideus; RR. pectorales → pectoral muscles.



4. A. thoracica lateralis → m. serratus ant.; RR. mammarii lat.
5. A. subscapularis → A. circumflexa scapulae - goes through foramen omotricipitale to fossa infraspinata and anastomoses with a. suprascapularis. A. thoracodorsalis → m. latissimus dorsi

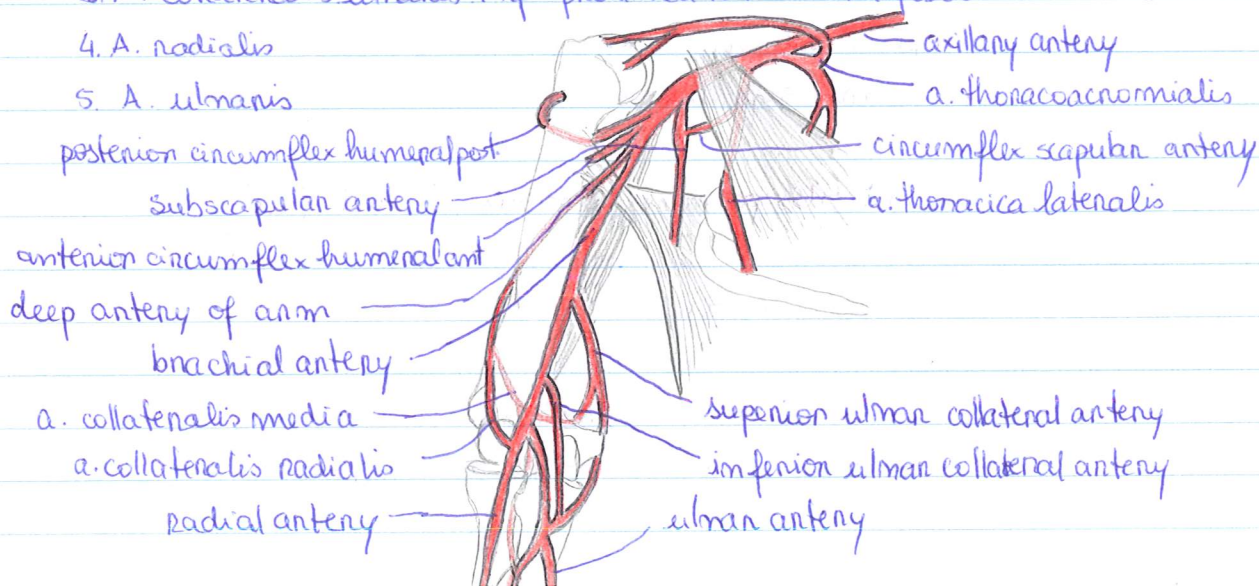


6. A. circumflexa humeri ant. - anterior to collum chirurgicum humeri - shoulder joint and m. deltoideus
7. A. circumflexa humeri post. - goes through foramen humerotricipitale - m. deltoideus.



The brachial artery is the continuation of the axillary artery from the inferior border of the pectoralis major to its division into the arteries of the forearm. It ends in the cubital fossa.

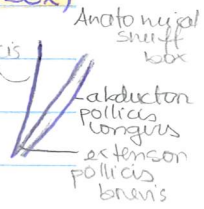
1. A. profunda brachii - runs between medial and lateral heads of triceps through sulcus nervi radialis. R. deltoideus → m. deltoideus; a. nutricia humeri; a. collateralis media and a. collateralis radialis → RETE ARTICULARE CUBITI
2. A. collateralis ulnaris sup. - septum intermusculare mediale - RETE ARTICULARE CUBITI
3. A. collateralis ulnaris inf - proximal to the cubital fossa - RETE ARTICULARE CUBITI
4. A. radialis
5. A. ulnaris



53. The antebrachial and hand arteries

RADIAL ARTERY

It continues in the same direction of the brachial artery which runs along the radius. Its proximal portion lies between the pronator teres and brachioradialis and its distal portion between the tendons of the brachioradialis and flexor carpi radialis. It turns posteriorly and passes between the first two metacarpals to reach the palms of the hand. It runs in foveola radialis (anatomical snuff box) - between the tendons of m. extensor pollicis brevis and longus.



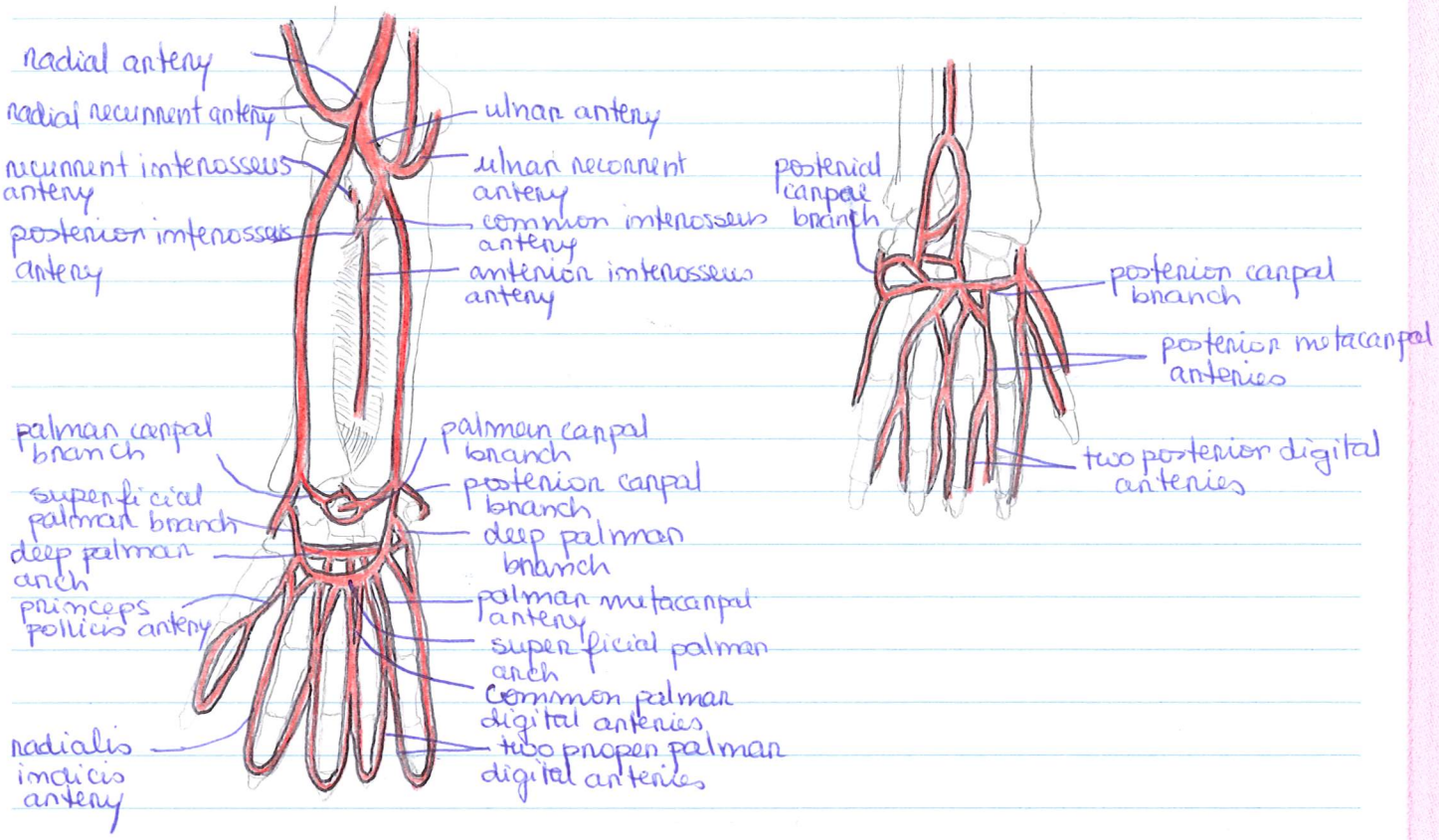
Branches:

- A. recurrens radialis - RETE ARTICULARE CUBITI; r. musculares
- R. carpeus palmaris - RETE CARPI PALMARE
- R. palmaris superficialis → arcus palmaris superficialis
- R. palmaris profundus → arcus palmaris profundus main branch
- R. carpeus dorsalis → RETE CARPI DORSALE
  - ↳ 3. aa. metacarpeae dorsales - which each of sends 2 aa. digitales dorsales propriae
  - ↳ a. metacarpea dorsalis prima
  - ↳ a. princeps pollicis

ULNAR ARTERY

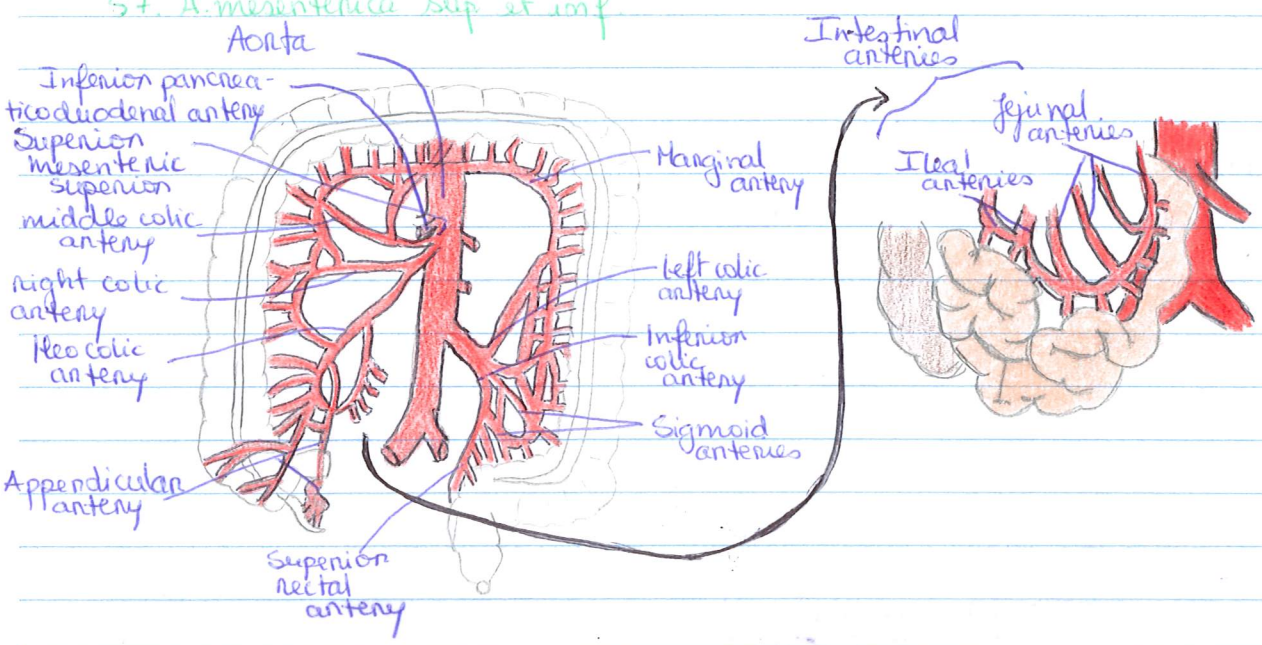
The ulnar artery is the longer of the two arteries of the forearm. It initially runs between the m. flexor digitorum profundus and superficialis, distally between tendons of the m. flexor carpi ulnaris and m. flexor digitorum superficialis and accompanies the ulnar nerve, over the retinaculum flexorum

- A. recurrens ulnaris - RETE ARTICULARE CUBITI
- A. interossea communis
  - ↳ a. interossea ant. → a. nutricia on the dorsal side of the forearm - RETE CARPI DORSALE / RETE CARPI PALMARE
  - ↳ a. interossea post. → extensors, a. recurrens interossea → RETE ARTICULARE CUBITI ↳ RETE CARPI DORSALE
- R. musculares
- R. carpeus dorsales - RETE CARPI DORSALE
- R. carpeus palmaris - RETE CARPI PALMARE
- R. palmaris superficialis - arcus palmaris superficialis (it's larger tributary)
  - ↳ 3 aa. digitales palmares communes - each of which sends 2 a. digitales palmares propriae
  - ↳ a. palmaris digiti quinti ulnaris
  - ↳ a. princeps pollicis
- R. palmaris profundus - arcus palmaris profundus
  - ↳ a. metacarpea palmaris → rr. perforantes (to aa. metacarpeae dorsales).



Artery	Origin	Course in Forearm
Ulnar	As larger terminal branch of brachial artery in cubital fossa	Descends inferomedially and then directly inferiorly, deep to superficial (pronator teres and palmaris longus) and intermediate (flexor digitorum superficialis) layers of flexor muscles to reach medial side of forearm; passes superficial to flexor retinaculum at wrist in ulnar (Guyon) canal to enter hand
Anterior ulnar recurrent artery	Ulnar artery just distal to elbow joint	Passes superiorly between brachialis and pronator teres, supplying both; then anastomoses with inferior ulnar collateral artery anterior to medial epicondyle (Fig. 6.67, palmar view)
Posterior ulnar recurrent artery	Ulnar artery distal to anterior ulnar	Passes superiorly, posterior to medial epicondyle and deep to tendon of flexor carpi ulnaris; then recurrent artery anastomoses with superior ulnar collateral artery
Common interosseous	Ulnar artery in cubital fossa, distal to bifurcation of brachial artery	Passes laterally and deeply, terminating quickly by dividing into anterior and posterior interosseous arteries
Anterior interosseous	As terminal branches of common interosseous artery, between radius and ulna	Passes distally on anterior aspect of interosseous membrane to proximal border of pronator quadratus; pierces membrane and continues distally to join dorsal carpal arch on posterior aspect of interosseous membrane
Posterior		Passes to posterior aspect of interosseous membrane, giving rise to recurrent interosseous artery; runs distally between superficial and

57. A. mesenterica sup et inf



Artery	Origin	Course	Distribution
Superior mesenteric	Abdominal aorta	Runs in root of mesentery to ileocecal junction	Part of gastrointestinal tract derived from midgut
Intestinal (jejunal and ileal) (n=15–18)	Superior mesenteric artery	Passes between two layers of mesentery	Jejunum and ileum
Middle colic		Ascends retroperitoneally and passes between layers of transverse mesocolon	Transverse colon
Right colic		Passes retroperitoneally to reach ascending colon	Ascending colon
Ileocolic	Terminal branch of superior mesenteric artery	Runs along root of mesentery and divides into ileal and colic branches	Ileum, cecum, and ascending colon
Appendicular	Ileocolic artery	Passes between layers of mesoappendix	Appendix
Inferior mesenteric	Abdominal aorta	Descends retroperitoneally to left of abdominal aorta	Supplies part of digestive tract derived from hindgut
Left colic	Inferior mesenteric artery	Passes retroperitoneally toward left to descending colon	Descending colon
Sigmoid (n = 3–4)		Passes retroperitoneally toward left to descending colon	Descending and sigmoid colon
Superior rectal	Terminal branch of inferior mesenteric artery	Descends retroperitoneally to rectum	Proximal part of rectum
Middle rectal	Internal iliac artery	Passes retroperitoneally to rectum	Midpart of rectum
Inferior rectal	Internal pudendal artery	Crosses ischioanal fossa to reach rectum	Distal part of rectum and anal canal

58 A. iliaca communis, a. iliaca interna

The internal iliac artery is the principal artery of the pelvis, supplying most of the blood to the pelvic viscera and some to the musculoskeletal part of the pelvis; however, it also supplies branches to the glutеal region, medial thigh regions, and the perineum.

Each internal iliac artery, approximately 4 cm long, begins as the common iliac artery and bifurcates into the internal and external iliac arteries at the level of the IV disc between the L5 and S1 vertebrae. The ureter crosses the common iliac artery or its terminal branches at or immediately distal to the bifurcation. The internal iliac artery is separated from the sacroiliac joint by the internal iliac vein

and obturator lesser pelvis, medial to the external iliac vein and obturator nerve, and lateral to the peritoneum.

Parietal branches:

1. A. iliolumbalis - runs superolaterally to the iliac fossa. Within the fossa, the artery divides into:
   - R. iliacus - m. iliacus
   - R. lumbalis - m. psoas major and m. quadratus lumborum
   - R. sacralis - vertebral canal
2. A. sacralis lat. - pass medially and descend anterior to the sacral anterior rami and pass through them → R. spinales → sacral canal. Some branches of these arteries pass from the sacral canal through the posterior sacral foramina and supply the erector spinae muscles of the back and the skin overlying the sacrum.
3. A. obturatoria - it arises close to the origin of the umbilical artery, where it is crossed by the ureter. It runs anteroinferiorly on the obturator fascia on the lateral wall of the pelvis and passes between the obturator nerve and vein. Within the pelvis, the obturator artery gives off:
   Before obturator canal:
   - R. pubicus - anastomoze with R. pubicus from a. epigastrica inf. → CORONA MORTIS
   - R. anterior - adductors of the thigh
   - R. posterior - A. acetabularis alongside the lig. capitis femoris to the head of the femur (NOTE: may cause problems in children).
4. A. glutea sup. - goes through foramen suprapiriforme
   - R. superficialis → m. gluteus max. et med.
   - R. profundus → m. gluteus med et min.
5. A. glutea inf. - it passes posteriorly between the sacral nerves (usually S2 and S3) and leaves the pelvis through the inferior part of greater sciatic foramen, inferior to the piriformis muscle → m. gluteus max.
   ↳ a. comitans n. ischiadici → sciatic nerve

Visceral branches:

1. A. umbilicalis - the umbilical arteries are the main continuation of the internal iliac arteries, passing along the lateral pelvic wall and then ascending the anterior abdominal wall to and through the umbilical ring into the umbilical cord.

Prenatally, the umbilical arteries conduct oxygen-and-nutrient-deficient blood to the placenta for the replenishment.

The occluded parts form fibrous cords called the medial umbilical ligaments. The ligaments raise folds of peritoneum (medial umbilical folds) on the deep surface of the anterior abdominal wall. lig. umbilicale lat., patent to - aa. vesicales sup.

2. A. vesicales inf. → lower part of the urinary bladder and the fornix vaginae in females and seminal vesicles in males.

3. A. rectalis media → middle part of the rectum. It anastomoses with the sup. and inferior rectal arteries.

4. a) A. uterina - crosses the ureter (about 2 cm from the cervix and 1,5 cm above the vaginal fornix - the artery is anteriorly) It descends on the lateral wall of the pelvis, anterior to the internal iliac artery, and passes medially to reach the junction of the uterus and vagina. As it passes medially, the uterine artery passes directly superior to the ureter - "Water (ureine) passes under the bridge (uterine artery)

- n. ureterici
- a. vaginalis ant. et post.
- nn. uterini
- n. tubarius
- n. ovaricus

4. b) A. ductus deferentis

- R. descendens - accompanies the ductus deferens to the scrotum, anastomoses with a. testicularis
- n. ascendens - seminal vesicle
  - ↳ n. ureterici - terminal part of the ureter

5. A. pudenda interna - passes inferolaterally, anterior to the piriformis muscle and sacral plexus. It leaves the pelvis between the piriformis and the coccygeus muscles by passing through the infrapiriformis foramen. The internal pudendal artery then passes around the posterior aspect of the ischial spine on the sacrospinous ligament and enters the ischioanal fossa through the lesser sciatic foramen.

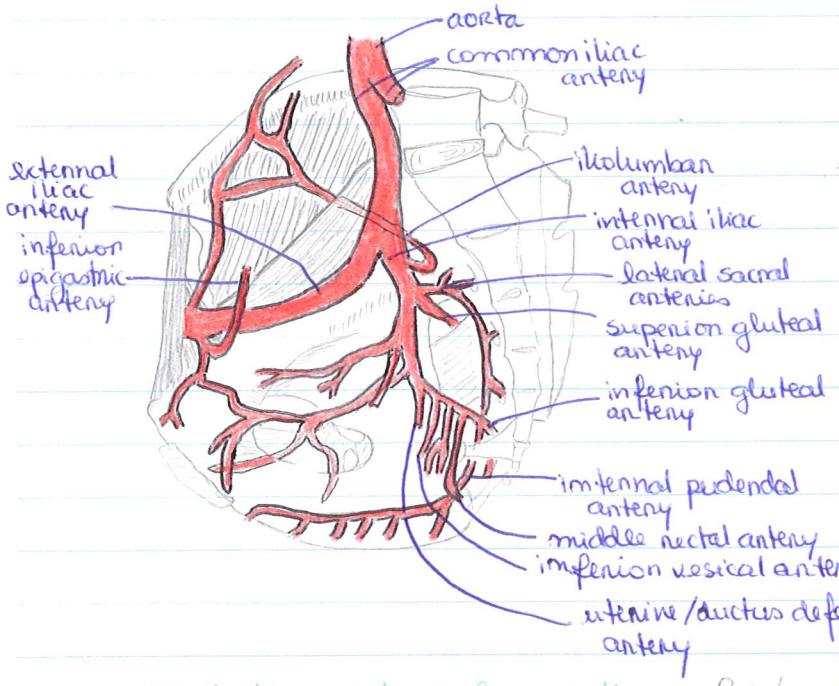
The internal pudendal artery, along with the internal pudendal veins and branches of the pudendal nerve, passes through the pudendal canal in the lateral wall of the ischioanal fossa. As it exists the pudendal canal, medial to the ischial tuberosity, the internal pudendal artery divides into:

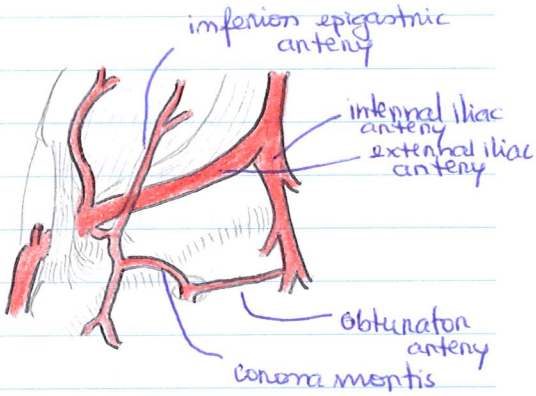
- a. rectalis inf → canalis analis
- a. perinealis → nn. scrotales (labiales) post.
- a) a. penis
  - a. bulbi penis
  - a. urethralis
  - a. profunda penis - cavernous body - aa. helicinae open into cavernae →
  - a. dorsalis penis - dorsal side of penis

/Rectum

rect sup	mesenterica	inf.
media	iliaca int.	
inf	pudenda int.	

- b) a. clitoridis
  - a. bulbi vestibuli
    - a. profunda clitoridis
    - a. dorsalis clitoridis





59. A. iliaca ext., a. femoralis R>L because Abd Aort is to left of vert crosses com iliac v.

EXTERNAL ILIAC ARTERY

The second branch of the common iliac artery is the external iliac artery. It courses parallel to the linea terminalis and medial to the iliopsoas to the vascular space. After traveling through this passage, it continues as the femoral artery.

1) A. epigastrica inf. - arises immediately above the inguinal ligament. It curves forward in the subperitoneal tissue, and then ascends obliquely along the medial margin of the abdominal inguinal ring; continuing its course upward, it pierces the transversalis fascia and ascends between the rectus abdominis and the posterior lamella of its sheath - anastomoses with a. epigastrica sup. (from a. thoracica int.)
   - R. pubicus - anastomoses with r. pubicus a. obturatoriae
   - a) a. cremasterica - male
   - b) a. ligamenti teretis - female

Lat umbilical fold

2) A. circumflexa ilium prof. → spina iliaca ant. sup.

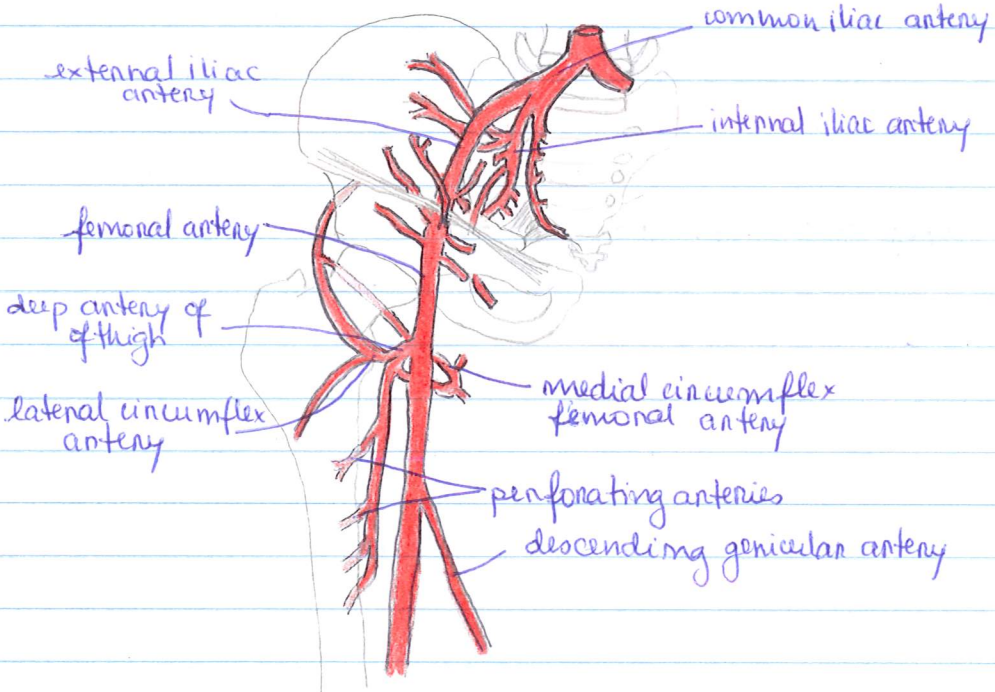
FEMORAL ARTERY

The femoral artery, the continuation of the external iliac artery distal to the inguinal ligament, is the primary artery of the lower limb. It enters the femoral triangle deep to the midpoint of the inguinal ligament (midway between the ASIS and the pubic tubercle), lateral to the femoral vein.

It lies and descends on the adjacent borders of the iliopsoas and pectineus muscles that form the floor of the triangle.

Posterior to the sartorius it travels in the adductor canal which gives it passage to the posterior side of the thigh and popliteal fossa where it becomes the popliteal artery.

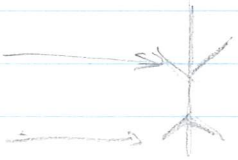
1. A. epigastrica spf. → anterior abdominal wall
2. A. circumflexa ilium spf. → spina iliaca ant. sup. ASIS
3. Aa. pudendae ext. → nn. scrotales (labiales) ant.
4. A. profunda femoris → fossa iliopectinea
   - ↳ a. circumflexa femoris medialis → neck and head of femur - posteriorly, anastomoses with the lateral circumflexa artery
     - R. spf. - adductors
     - R. prof. - m. adductor magnus, flexors and hip joint
   - ↳ a. circumflexa femoris lateralis
     - R. ascendens - anastomoses with the gluteal arteries and the medial circumflex artery
     - R. descendens to the knee joint
   - ↳ a. perforans prima - below m. pectineus posteriorly - flexors
     - a. nutricia superioris
   - ↳ a. perforans secunda - in the middle of the femur - flexors
   - ↳ a. perforans tertia - terminal, 3cm above the hiatus tendineus - flexors
     - a. nutricia inferiores
5. Rr. musculares
6. A. genus descendens - goes through canalis adductorius → RETE ARTICULARE GENUS
   - ↳ R. saphenus



60. A. poplitea, a. tibialis ant.

The popliteal artery, the continuation of the femoral artery, begins when the latter passes through the adductor hiatus. The popliteal artery passes inferolaterally through the popliteal fossa and ends at the inferior border of the popliteus by dividing into the anterior and posterior tibial arteries. The deepest (most anterior) structure in the fossa, the popliteal artery, runs in close proximity to the joint capsule of the knee as it spans the intercondylar fossa (deep to the vein and nerve).

1. Aa. surales → m. gastrocnemius
2. A. genus sup. med. et lat. - RETE ARTICULARE GENUS
3. A. genus media → knee joint
4. A. genus inf. med. et lat. - RETE ARTICULARE GENUS
5. A. tibialis ant.
6. A. tibialis post.



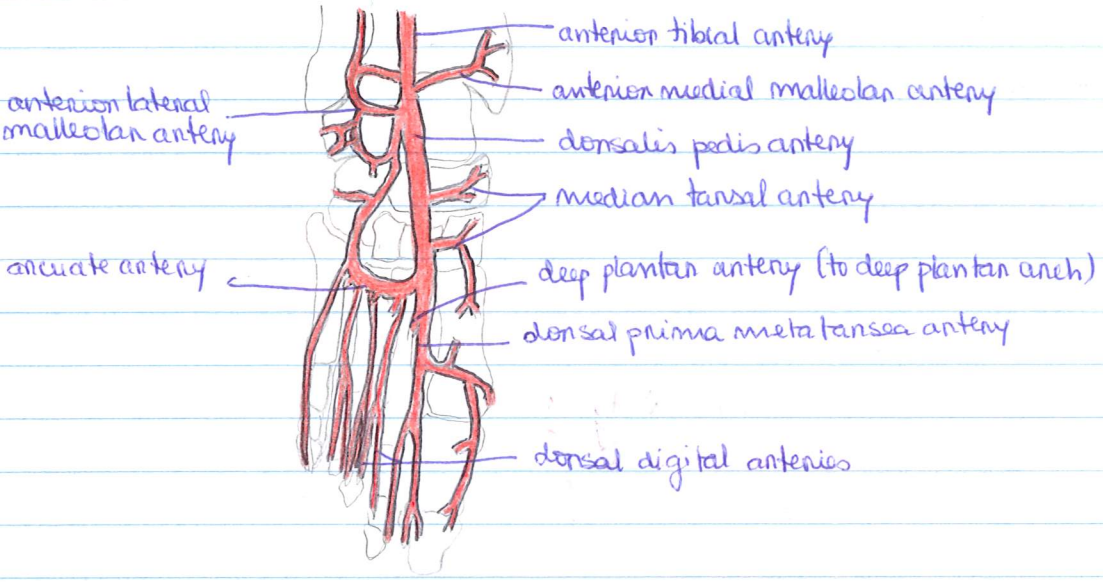
ANTERIOR TIBIAL ARTERY

The anterior tibial artery supplies structures in the anterior compartment. It begins at the inferior border of the popliteus muscle. The artery immediately passes anteriorly through a gap in the superior part of the interosseus membrane to descend on the anterior surface of this membrane between the m. tibialis ant. and m. extensor digitorum longus and distally between m. tibialis anterior and m. extensor hallucis longus. At the ankle joint, midway between the malleoli, the anterior tibial artery changes names, becoming the dorsalis pedis artery.

1. A. recurrens tibialis post. - RETE ARTICULARE GENUS
2. A. recurrens tibialis ant. - RETE ARTICULARE GENUS
3. Rr. musculares
4. A. malleolaris ant. med et lat. - RETE MALLEOLARE MED. ET LAT.
5. A. dorsalis pedis - begins midway between the malleoli and runs anteromedially, deep to the inferior extensor retinaculum between the extensor hallucis longus and the extensor digitorum longus tendons on the dorsum of the foot.
   - aa. tarsea med. - medial margin of the foot
   - a. tarsea lat. - deep to m. extensor hallucis brevis and m. extensor digitorum brevis, anastomoses with a. arcuata.
     ↳ a. digitalis dorsalis I.
   - a. arcuata - laterally - with a. tarsea lat. forms the arch convex distally
     ↳ 3. aa. metatarsea dorsales - each of which divides into 2 aa. digitales dorsales
   - a. metatarsea dorsalis prima - aa. digitales dorsales for both sides of the

big toe and the medial margin of the 2nd toe

- R. plantaris prof. - runs to planta pedis - anastomoses with a. plantaris lat.



61. A. tibialis posterior

The posterior tibial artery provides the blood supply to the posterior compartment of the leg and to the foot. It begins at the distal border of the popliteus as the popliteal artery passes deep to the the tendinous arch of the soleus and simultaneously bifurcates into its terminal branches.

During its descent, the posterior tibial artery is accompanied by the tibial nerve and veins. The artery runs posterior to the medial malleolus, from which it is separated by the tendons of the tibialis posterior and flexor digitorum longus. Inferior to medial malleolus, it runs between the tendons of the flexor hallucis longus and flexor digitorum longus.

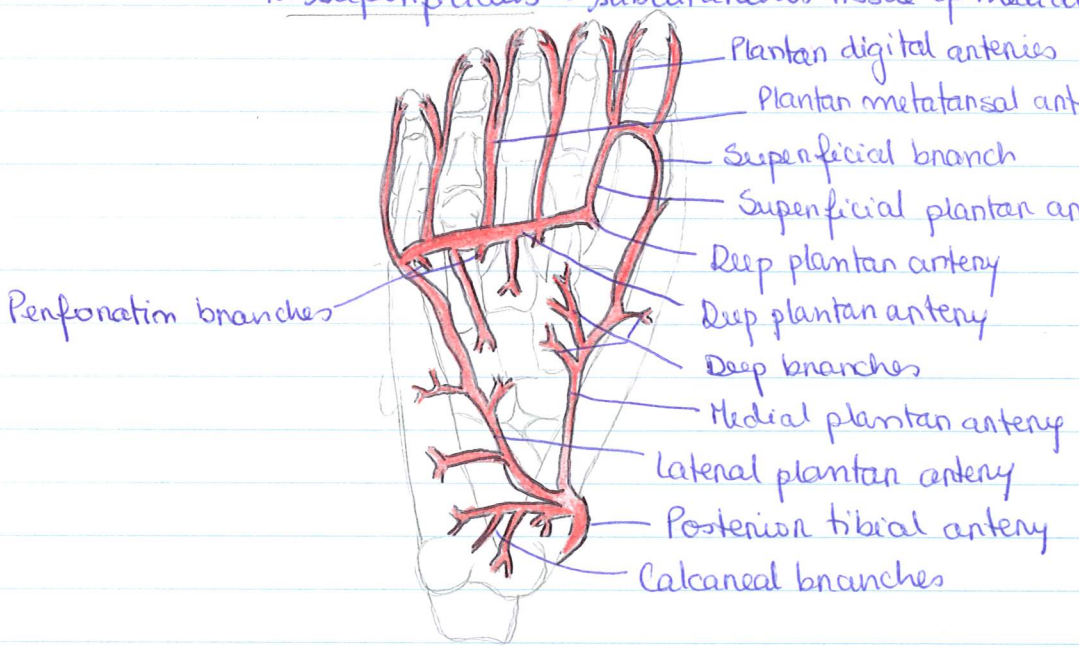
1. R. circumflexus fibulae - RETE ARTICULARE GENUS
2. A. peronea / fibularis - arises inferior to the distal border of the popliteus and the tendinous arch of the soleus. It descends obliquely toward the fibula and passes along its medial side, usually within the flexor hallucis longus.
   - ↳ RR. musculares
   - ↳ a. nutritia fibulae
   - ↳ R. communicans - anastomoses with a. tibialis post.
   - ↳ R. perforans - RETE DORSALES PEDIS
   - ↳ RR. malleolares lat. - RETE MALLEOLARE LAT.
   - ↳ RR. calcanei lat. - RETE CALCANEI LAT.
3. RR. musculares
4. A. nutritia tibiae
5. RR. malleolares med - RETE MALLEOLARE MED.
6. RR. calcanei med
7. A. plantaris lat. - runs between m. flexor digitorum brevis and m. quadratus plantae. It forms arcus plantaris with R. plantaris profundus from a. dorsalis

Structures behind medial ankle: T; O; A V N Hallucis

pedis and with n. profundus from a. plantaris medialis

Arcus plantaris: 4 aa. metatarsae plantares → aa. digitales plantares
→ nn. perforantes

8. A. plantaris media - runs between m. abductor hallucis and m. flexor digitorum brevis
↳ n. profundus → muscles of medial side of the foot
↳ n. superficialis → subcutaneous tissue of medial side of the foot.



62. Vena cava superior, the vena jugularis interna

SUPERIOR VENA CAVA

The superior vena cava arises from the union of the right and left brachiocephalic veins, which carry blood to the heart from the head and neck via the internal jugular vein as well as from the arms via the subclavian vein. The superior vena cava returns blood from all structures superior to the diaphragm, except the lungs and heart. The main lymphatic trunks open at the union of the subclavian vein and internal jugular vein, the "venous angle" - the right lymphatic duct on the right side and the thoracic duct on the left side.

It passes inferiorly and ends at the level of the 3rd costal cartilage, where it enters the right atrium of the heart. The superior vena cava lies in the right side of the superior mediastinum, anterolateral to the trachea and posterolateral to the ascending aorta. The right phrenic nerve lies between the SVC and the mediastinal pleura.

The SVC is 6 cm long and 2-3 cm in diameter.

- Azygos vein - located on the right side of the body, the azygos vein begins in the abdominal cavity as the ascending lumbar and empties at the level of ~~L4~~ on L5 via the arch of the azygos vein into the superior vena cava.

- v. lumbalis ascendens dx. and v. subcostalis dx.
- vv. intercostales post. dx. (8-10)
- v. intercostalis suprema dx. - vv. intercostales post. dx. (2-3)
- v. hemiazygos - on the left side of the body, the hemiazygos vein also arises from the ascending lumbar vein and receives the corresponding tributaries. It empties at the level of T9 on T10 into the azygos vein.
  - ↳ v. lumbalis asc. sim. - vv. lumbales sim.
  - ↳ vv. intercostales post. sim. (3-5)
  - ↳ v. hemiazygos accessoria - vv. intercostales post. sim (5)
    - v. intercostalis suprema sim.
  - ↳ vv. oesophageae, bronchiales, mediastinales
  - ↳ v. phrenica sup. sim.
- vv. oesophageae, bronchiales, mediastinales
- v. phrenica sup. dx.

VENA JUGULARIS INTERNA

The IJV drains blood from the brain, anterior face, cervical viscera, and deep muscles of the neck. It commences at the jugular foramen in the posterior cranial fossa as the direct continuation of the sigmoid sinus.

From a dilation at its origin, the superior bulb of the IJV, the vein descends in the carotid sheath, accompanying the internal carotid artery superior to the carotid bifurcation and the common carotid artery and vagus nerve inferiorly. The vein lies laterally within the sheath, with the nerve located posteriorly.

The IJV leaves the anterior cervical region by passing deep to the SCM. The inferior end of the veins passes deep to the gap between the sternal and the clavicular heads of this muscle. Posterior to the sternal end of the clavicle, the IJV merges with the subclavian vein to form the brachiocephalic vein. The inferior end of the IJV dilates to form the inferior bulb of the IJV. This bulb has a bicuspid valve that permits blood to flow toward the heart while preventing backflow into the vein, as might occur if inverted (e.g. intrathoracic pressure is increased).

Intracranial tributaries:
- Sinus durae matris → sigmoid sinus - it leaves the cranium through the jugular foramen and enters the superior bulb of the IJV.

Extracranial tributaries:
- vv. pharyngeae - venous plexus on the pharyngeal wall and empty into the IJV at the level of the angle of the mandible.
- v. facialis - empties into the IJV at the level of the origin of the lingual artery.
  - ↳ v. angularis

↳ v. prof. faciei - plexus pterygoideus of the infratemporal fossa
↳ v. palatina ext.

- v. lingualis - empties into the IJV at the level of origin of the lingual artery
- v. thyroidea sup. - plexus thyroideus impar (v. laryngea sup.)
- v. thyroidea media
- v. temporalis media
- v. transversa faciei
- v. retromandibularis (35%; most commonly it drains to external jugular vein)

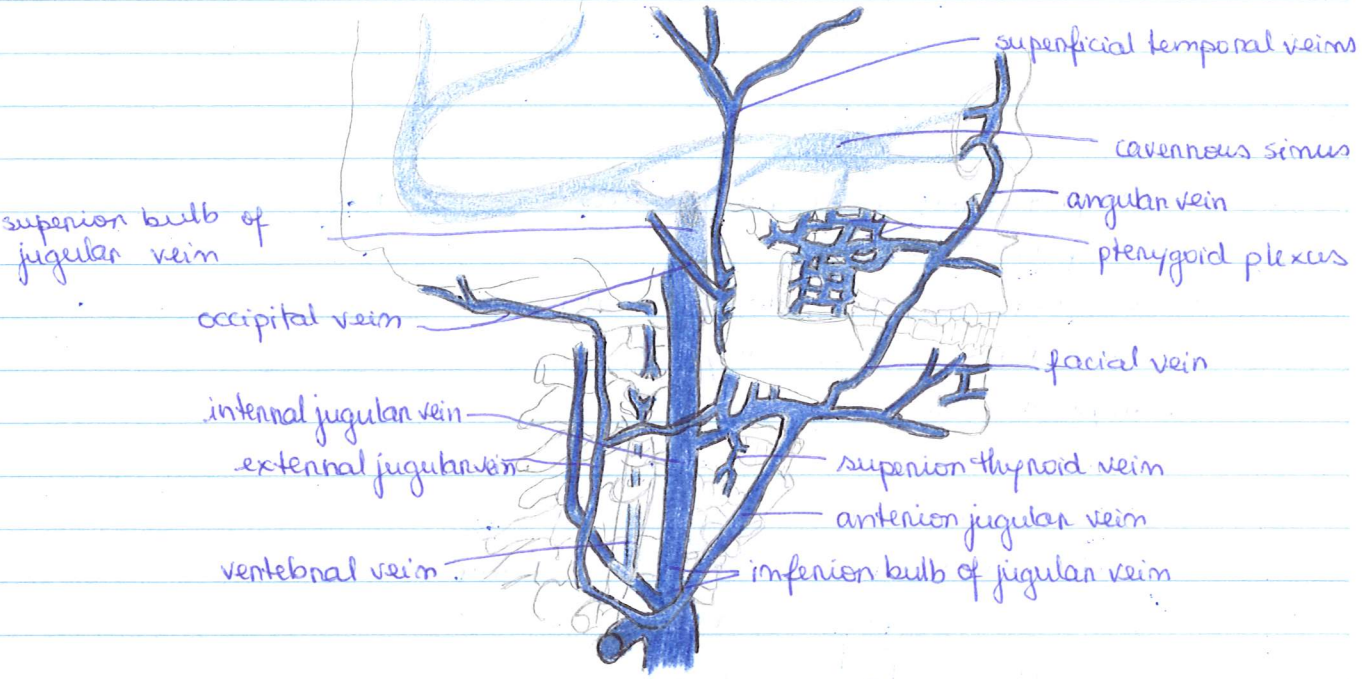
• PLEXUS PTERYGOIDEUS:
- v. alveolaris inf. et sup.
- v. sphenopalatina
- vv. palatinae

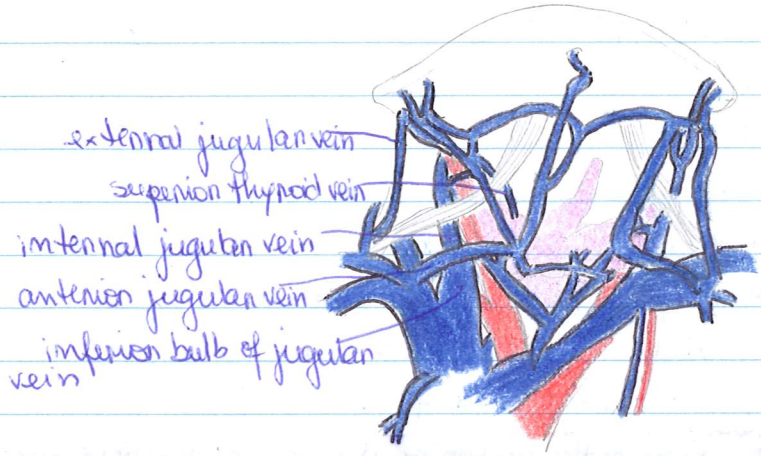
Blood from the plexus flows:
✓ through vv. ophtalmicae > sinus cavernosus
✓ through v. maxillaris > v. retromandibularis
✓ through v. prof. faciei > v. facialis

- v. jugularis ext. - begins near the angle of the mandible (just inferior to the auricle) by the union of the posterior division of the retromandibular vein with the posterior auricular vein. The EJV crosses the SCM obliquely, deep to the platysma, and enters the anteroinferior part of the lateral cervical region. It then pierces the investing layer of deep cervical fascia, which forms the roof of this region, at the posterior border of the SCM. The EJV descends to the inferior part of the lateral cervical region and terminates in the subclavian vein. It drains most of the scalp and side of the face.

↳ v. retromandibularis - runs posterior to the ramus of the mandible within the substance of the parotid gland, superficial to the external carotid artery and deep to the facial nerve.
• v. temporalis spf
• v. maxillaris

↳ v. auricularis post.
↳ v. occipitalis
↳ v. jugularis ant. (v. mediana colli) - arcus venosus juguli - transverse vessel connecting it to its counterpart from the opposite side.
↳ v. transversa colli
↳ v. suprascapularis





Vein	Origin	Course	Termination	Area Drained
Supratrochlear	Begins from venous plexus on forehead and scalp, through which it communicates with frontal branch of superficial temporal vein, its contralateral partner, and supra-orbital vein	Descends near midline of forehead to root of nose, where it joins supra-orbital vein	Angular vein at root of nose	Anterior part of scalp and forehead
Supra-orbital	Begins in forehead by anastomosing with frontal tributary of superficial temporal vein	Passes medially superior to orbit; joins supra-trochlear vein; a branch passes through supra-orbital notch and joins with		

63. Sinus and veins of dura matris

The rigid walls of the venous channels are formed by the cranial periosteum and dura mater. The interior of these valveless sinuses is lined with endothelium.

At the level of the internal occipital protuberance, several larger dural venous sinuses merge to form the confluence of sinuses.

The transverse sinus begins at the confluence of sinuses and continues laterally as sigmoid sinus. The sigmoid sinus has an S-shaped course along the posterior inferior border of the petrous part of the temporal bone to the jugular foramen where the internal jugular vein arises.

The marginal sinus encircles the foramen magnum and connects the dural venous sinuses with the vertebral venous plexuses

The unpaired occipital sinus begins at the foramen magnum and travels within the root of the falx cerebelli.

The basilar plexus refers to the venous plexus lying on the clivus.

The cavernous sinus lies on either side of the sella turcica and pituitary gland.

Communicating with the cavernous sinus are:

- the angular vein via the superior ophtalmic vein.
- the superior sagittal sinus via the sphenoparietal sinus.
- the cavernous sinus of the opposite side via the intercavernous sinuses.
- the internal jugular vein via the inferior petrosal sinus which runs on both part of the temporal bone and receives the labyrinthine veins from the internal ear.
- the sigmoid sinus via the superior petrosal sinus

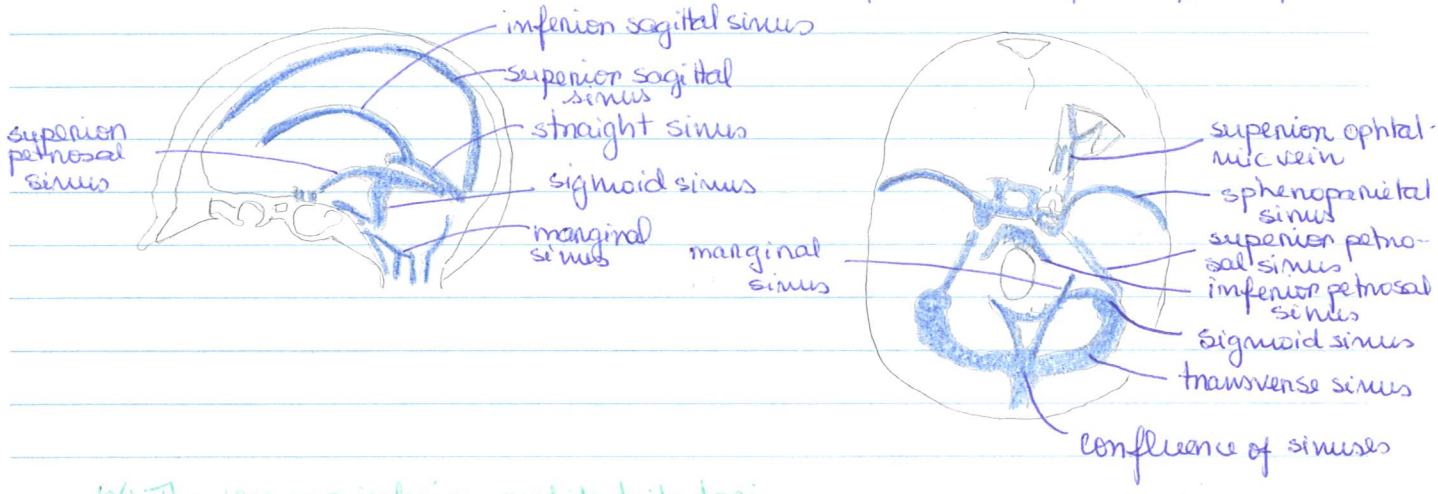
The inferior sagittal sinus runs within the inferior border of the falx cerebri. It ends above the straight sinus in the confluence of sinuses.

Superficial cerebral veins empty directly into the the dural venous sinuses, and deep cerebral veins, which drain via the great cerebral vein into the dural venous sinuses.

Diploic veins. - The diploic veins lie in the diploe (spongy substance) of the cranial bones and communicate with the dural venous sinuses as well as the superficial veins of the head: the front diploic vein, anterior temporal diploic vein, posterior temporal diploic vein and occipital diploic vein

- Emissary veins: connect cranial venous sinuses to extracranial veins.
  - the parietal emissary vein (superior sagittal sinus - superficia temporal vein)
  - the mastoid emissary vein (sigmoid sinus - occipital vein)
  - the condylar emissary vein (sigmoid sinus - external vertebral venous plexus)
  - the occipital emissary vein (confluence of sinuses - occipital vein).

- the venous plexus of hypoglossal canal, venous plexus of foramen ovale, the internal carotid venous plexus, and pontal veins of the hypophysis.



64. The vena cava inferior and its tributaries

Parietal tributaries:

- v. iliaca communis dx. et sin.
- vv. lumbales - 4 pairs, v. lumbalis ascendens
- vv. phrenicae inf.
- v. sacralis mediana

Visceral tributaries

- v. testicularis dx - plexus pampiniformis
- v. ovarica dx. - plexus venosus ovaricus
- vv. renales - the left vein: v. suprarenalis sin., testicularis sin., or v. ovarica sin.
- v. suprarenalis dx.
- 2-3 vv. hepaticae

Note: The pampiniform plexus is a network of many small veins found in the human male spermatic cord. It is formed by the union of multiple spermatic veins from the back of the testis and tributaries. The veins of the plexus ascend along the cord in front of the ductus deferens

Vena Iliaca Communis

The inferior vena cava arises at the union of the right and left common iliac veins, which extend from the level of L4 to the sacroiliac joint and are derived from the confluence of the internal and external iliac veins.

Internal Iliac Vein

Parietal tributaries accompany arteries:

- the superior gluteal veins enter the pelvis through the suprapiriform foramen and merge to form a trunk that opens into the internal iliac vein.
- the inferior gluteal veins pass through the infrapiriform foramen
- the obturator veins which emerge from the obturator foramen into the pelvis.

- the lateral sacral which collect blood from the sacral venous plexus, a venous network lying anterior to the sacrum.

Viscenal tributaries arise from plexuses

- Plexus venosus vesicalis > vv. vesicales >> v. iliaca int.
  a) prostatic venous plexus as well as the deep posterior vein of penis
  b) vaginal venous plexus as well as the deep posterior vein of clitoris
- Plexus venosus uterinus - drains into the uterine veins. The venous plexuses of the urogenital organs are interconnected > v. uterinae, vaginales
- Plexus venosus rectalis drains mainly the superior rectal vein > v. inferior mesenteric > v. portae
- Venous blood from the pelvic floor and perineum is collected by the internal pudendal vein. Its tributaries are:
  - the veins of penis on deep veins of clitoris
  - the middle and inferior rectal veins
  - the posterior scrotal veins on posterior labial veins
  - the vein of bulb of penis on vein of bulbe of vestibule

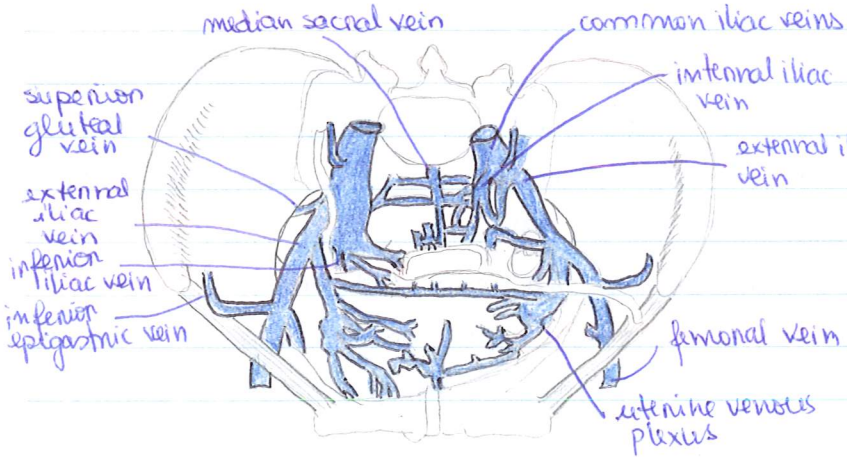
External Iliac Vein

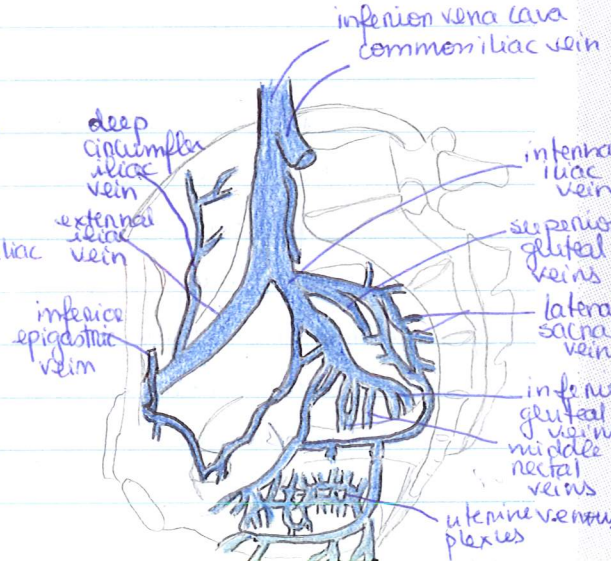
The external iliac vein is the proximal continuation of the femoral vein. During its course from below the inguinal ligament to its junction with the internal iliac vein, it collects blood from only 3 tributaries:

✓ the inferior epigastric vein, which runs on the posterior aspect of the anterior abdominal wall as the companion vein of the inferior epigastric artery.

✓ the pubic vein, which communicates with the obturator vein and in rare instances can replace it.

✓ the deep circumflex iliac vein, which arises from companion veins of the deep circumflex iliac artery.





65. The vena subclavia and its drains

SUBCLAVIAN VEIN

The subclavian vein is the continuation of the axillary vein draining the upper limb to the venous angle. It lies between the sternocleidomastoid and anterior scalene muscles and unites behind the sternoclavicular joint with the internal jugular vein.

Drains:

- v. transversa colli
- v. suprascapularis

AXILLARY VEINS

The axillary vein lies initially on the anteromedial side of the axillary artery, with its terminal part anteroinferior to the artery. This large vein is formed by the union of the brachial vein and the basilic vein at the inferior border of the teres major.

The axillary vein ends at the lateral border of the 1st rib, where it becomes the subclavian vein.

- vv. thoracoepigastricae → vv. subcutaneae abdominis. These veins constitute a collateral route that enables venous return in the presence of obstruction of the inferior vena cava.
- v. thoracica lat.
- vv. costoaxillares
- v. cephalica

VEINS OF ARM

Two sets of veins of the arm, superficial and deep, anastomose freely with each other. The superficial veins are in the subcutaneous tissue, and the deep veins accompany the arteries. Both sets of veins have valves, but they are more numerous in the deep veins than in the superficial veins.

✔ Deep veins

Paired deep veins, collectively constituting the brachial vein, accompany the brachial artery. (vv. digitales, radiales, ulnares, interosseae antebrachii, brachiales).

The brachial vein begins at the elbow by union of the accompanying veins of the ulnar and radial arteries and ends by merging with the basilic vein to form the axillary vein.

✔ Superficial veins

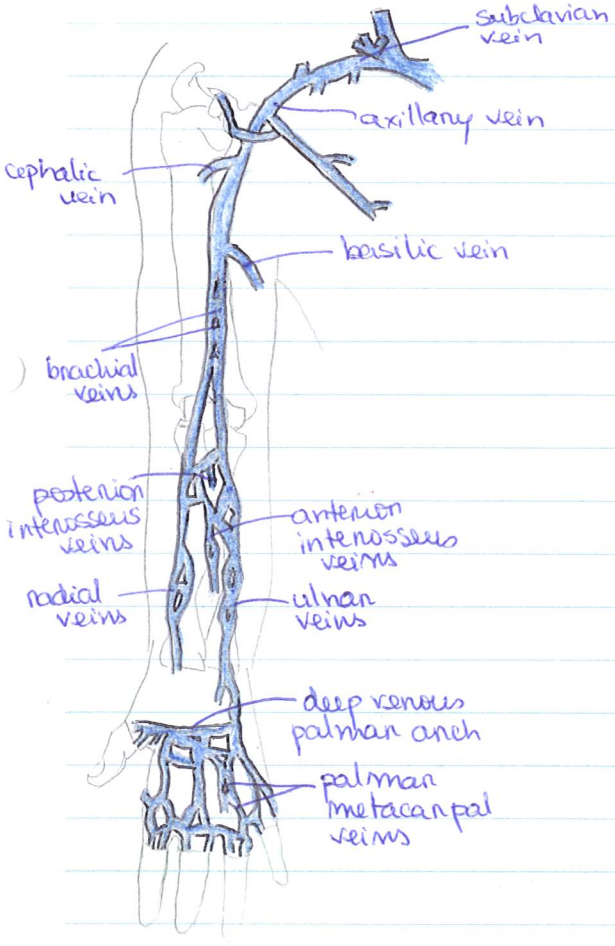
The main superficial veins of the upper limb, the cephalic and basilic veins, originate in the subcutaneous tissue on the dorsum of the hand from the dorsal venous network. Perforating veins form communications between the superficial and deep veins.

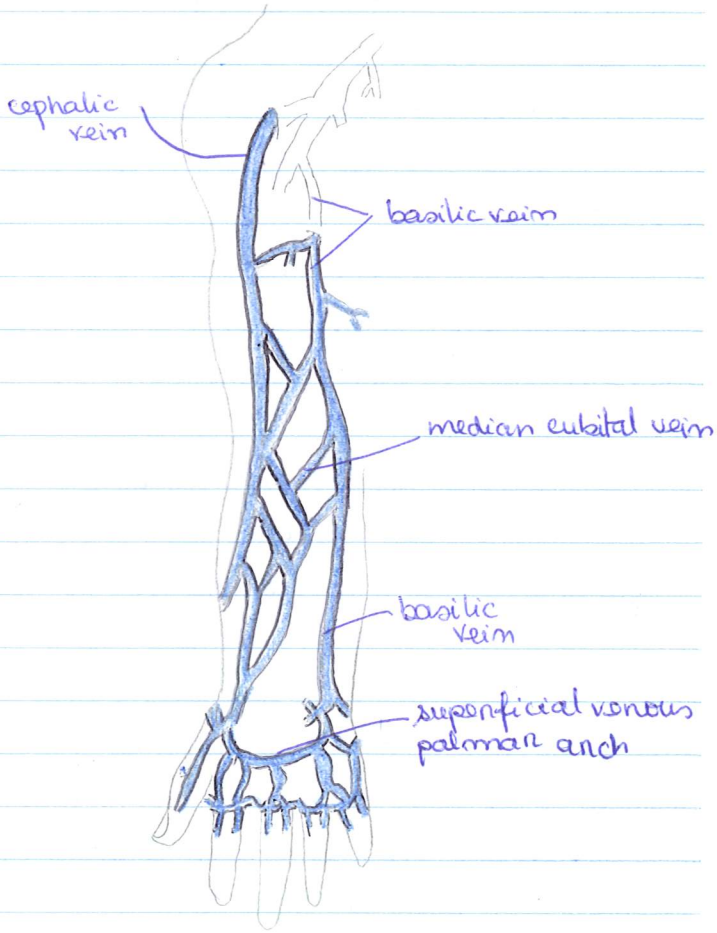
- The cephalic vein ascends in the subcutaneous tissue from the lateral aspect of the dorsal venous network, proceeding along the lateral border of the wrist and the anterolateral surface of the proximal forearm and arm. Anterior to the elbow, the cephalic vein communicates with the median cubital vein, which passes obliquely across the anterior aspect of the elbow in the cubital fossa and joins the basilic vein. The cephalic vein

courses superiorly between the deltoid and the pectoralis major muscles along the deltopectoral groove and enters the clavipectoral triangle. It then pierces the costocoracoid membrane and part of the clavipectoral fascia, joining the terminal part of the axillary vein.

- The basilic vein ascends in the subcutaneous tissue from the medial end of the dorsal venous network along the medial side of the forearm and the inferior part of the arm. It then passes deeply near the junction of the middle and inferior thirds of the arm, piercing the brachial fascia and running superiorly parallel to the brachial artery and the medial cutaneous nerve of the forearm to the axilla, where it merges with the accompanying veins of the axillary artery to form the axillary vein.

- The median antebrachial vein is highly variable. The median antebrachial vein sometimes divides into a median basilic vein, which joins the basilic vein, and a median cephalic vein, which joins the cephalic vein.





66. The veins of the lower extremities

VENOUS DRAINAGE OF LOWER LIMB

The lower limb has superficial and deep veins; the superficial veins are in the subcutaneous tissue, and the deep veins are deep to the deep fascia and accompany all major arteries.

- Deep veins

Deep veins accompany all the major arteries and their branches. Instead of occurring as a single vein in the limbs. The accompanying veins usually occur as paired. They are contained within a vascular sheath with the artery.

Veins accompanying the perforating arteries of the deep artery of the thigh drain blood from the thigh muscles and terminate in the deep vein of the thigh, which joins the terminal portion of the femoral vein. The femoral vein passes deep to the inguinal ligament to become the external iliac vein.

vv. digitales plantares, metatarsae plantares, tibiales post. et ant., peroneae, poplitea, femoralis, profunda femoris

- Superficial veins

The two major superficial veins in the lower limb are the great and small saphenous veins.

• GREAT SAPHENOUS VEIN

It ascends anterior to the medial malleolus and passes posterior to the medial condyle of the femur. It anastomoses freely with the small saphenous vein. It traverses the saphenous opening in the fascia lata and empties into the femoral vein.

Its tributaries are:

- v. marginalis med. - continuation of dorsal venous arch of the foot
- v. saphena accessoria - main communication between the great and small saphenous veins.
- v. epigastrica superficialis
- v. circumflexa ilium superficialis
- vv. pudenda externa

• SMALL SAPHENOUS VEIN

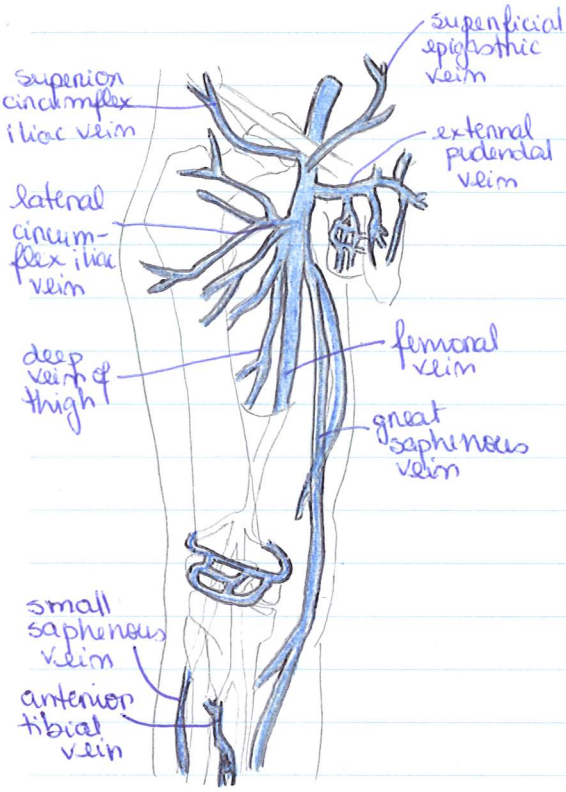
Arises on the lateral side of the foot and ascends posterior to the lateral malleolus as a continuation of the lateral marginal vein. It passes along the lateral border of the calcaneal tendon and inclines to the midline of the fibula and penetrates the deep fascia. Then, it ascends between the heads of the gastrocnemius muscle. It empties into the popliteal vein in the popliteal fossa.

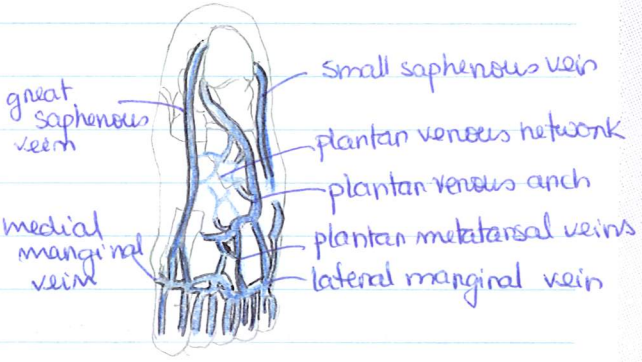
Its tributaries are:

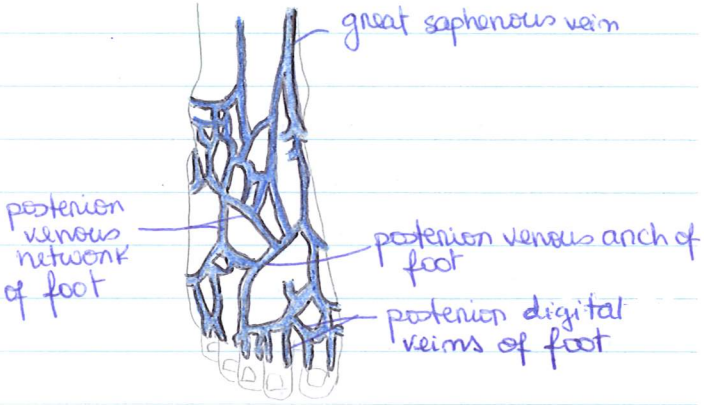
- v. marginalis lat.
- v. femoropoplitea > v. poplitea

• PERFORATING VEINS

They penetrate the deep fascia close to their origin from the superficial veins and contain valves that allow blood to flow only from the superficial veins to the deep veins.







67. The vena portae, the portal circuit and its function

It is formed anterior to the IVC and posterior to the neck of the pancreas (close to the level of the L1 vertebra and the transpyloric plane) by the union of the superior mesenteric and splenic veins.

Although the HPV is a large vessel, it runs a short course (7-8 cm), most of which is contained within the hepatoduodenal ligament. As it approaches the porta hepatis, the hepatic portal vein divides into right and left branches - interlobular veins. The hepatic portal vein collects blood with reduced oxygenation but rich in nutrients from the abdominal part of the digestive tract, including the gallbladder, pancreas, and spleen, and carries it to the liver.

Within the liver, its branches are distributed in a segmental pattern and end in expanded capillaries, the venous sinusoids of the liver.

Its tributaries are:

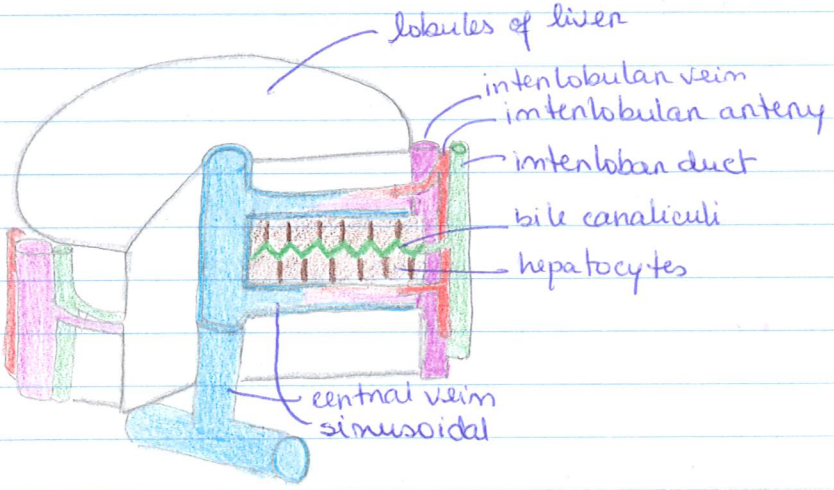
- vv. cysticae - gall bladder
- v. gastrica sin.
- v. gastrica dx.

- v. mesenterica sup.
  - vv. pancreaticoduodenales
  - vv. pancreaticae
  - v. gastroepiploica dx.
  - vv. jejunales et ileales
  - v. ileocolica
  - v. colica dx. et media
- v. lienalis
  - vv. gastricae breves
  - v. gastroepiploica sin.
  - vv. pancreaticae
- v. mesenterica inf.
  - v. colica sin.
  - vv. sigmoideae
  - v. rectalis sup.

FUNCTION: The portal venous system is responsible for directing blood from parts of the gastrointestinal tract to the liver. Substances absorbed in the small intestine travel first to the liver for processing before continuing to the heart. Not all of the gastrointestinal tract is part of this system. The system extends from about the lower portion of the esophagus to the upper part of the anal canal. It also includes venous drainage from the spleen and pancreas.

Many drugs that are absorbed through the GIT are substantially metabolized by the liver before reaching general circulation. As a consequence, certain drugs can only be taken via certain routes.

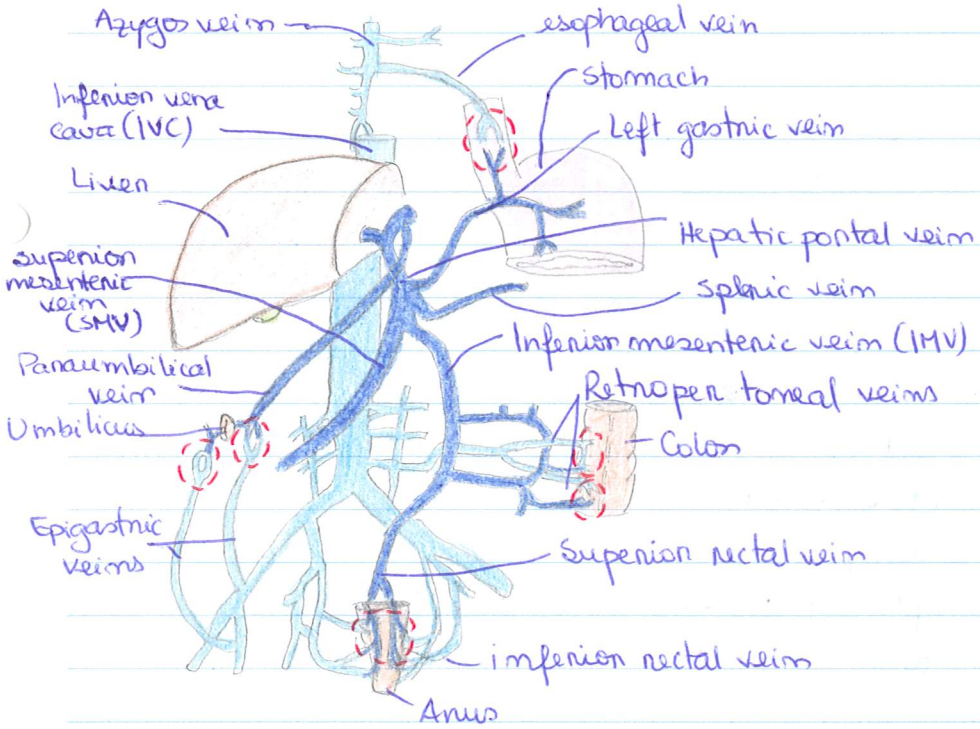
Blood passes from branches of the portal vein through cavities between "plates" of hepatocytes called sinusoids. Blood also flows from branches of the hepatic artery and mixes in the sinusoids to supply the hepatocytes with oxygen. The mixture percolates through the sinusoids and collects in a central vein which drains into the hepatic vein. The hepatic vein subsequently drains into the inferior vena cava.



68. The portocaval anastomoses

1. Vv. gastricae → vv. oesophageae
2. Connections around the umbilicus - vv. paraumbilicales (lig. teres hepatis) → subcutaneous veins of anterior abdominal wall (epigastric veins) - CAPUT MEDUSAE
3. Bennow's veins - plexus venosus vesicalis → paraumbilical veins
4. Plexus rectalis - between superior rectal vein and the others - HEMORRHOIDS
5. Retzius' veins: v. lienalis, vv. mesentericae → vv. renales, lumbales
6. Connections between hepatic veins and the phrenic veins at the bare of the liver.

When portal circulation through the liver is diminished or obstructed because of liver disease or physical pressure from a tumor, for example, blood from the digestive tract can still reach the right side of the heart through the IVC by way of these collateral routes. These alternate routes are available because the hepatic portal vein and its tributaries have no valves; hence blood can flow in a reverse direction to the IVC. However, the volume of blood forced through the collateral routes may be excessive, resulting in potentially fatal varices (abnormally dilated veins).



69. The structure of the lymphatic system, the ductus thoracicus, truncus lymphaticus dex.

LYMPHATIC VESSELS

Lymphatic vessels can basically be divided into the following segments:

- lymphatic capillaries

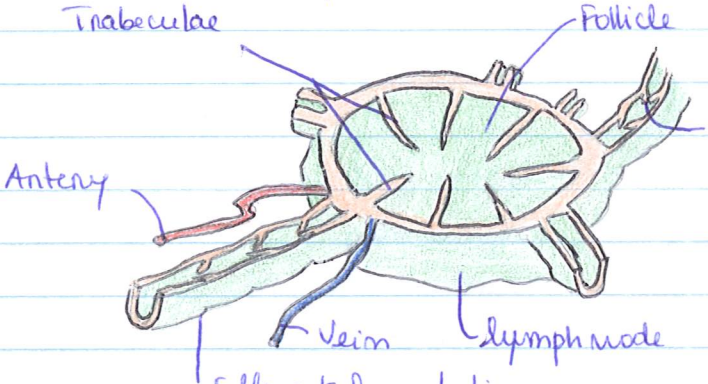
- lymphatic vessels on collectors
- langer lymphatic trunks

The lymphatic vessels begin in the intercellular spaces as blind vasa lymphocapillaria that form rete lymphocapillare. Lymph capillaries return to the circulation about 10% of tissue fluid. The lymph is conveyed through the system of lymphatic vessels to the venous angle and thus returned to the blood circulation. Lymph is a tissue fluid of extracellular spaces is produced by the metabolism of cells and filtrated from blood capillaries. Lymph in the intestine contains also nutrients and fats in small globules - chyle. Lymph contains lymphocytes. The flow of lymph is promoted by the pump, function of muscles, changes of intraabdominal pressure and respiratory movements of the thorax.

Lymphatic vessels possess valves and direct the flow of lymph toward the lymph nodes, which are intersposed at regular intervals along the course of the lymphatic vessels. Lymphatic vessels can be divided, according to their relation to the general layer of fascia, into superficial lymph vessels and deep lymph vessels. The lymph collected by lymphatic vessels ultimately flows into two large lymphatic trunks, the thoracic duct on the left and the right lymphatic duct on the right.

LYMPH NODE

is a bean-shaped organ, 1-30 mm, with smooth surface, whitish or grey-pink, located in the connective tissue as a single organ or in groups. Efferent vessels enter the node at its periphery, the efferent vessel leaves the node from the hilum (together with the vein and artery).



Tonsils - masses of lymphoid tissue - the immunological barrier at the beginning of the respiratory and digestive tracts.

SPLEEN

It's the largest lymphatic organ. Prenatally, the spleen is a hematopoietic (blood-forming) organ, but after birth is involved primarily in identifying, removing, and destroying expanded red blood cells (RBC's) and broken-down platelets, and in recycling iron and globin. The spleen serves as a blood reservoir, storing RBCs and platelets, and, to a limited degree, can provide a sort of "self transfusion" as a

response to the stress imposed by hemorrhage. → RED PULP

It also participates in the body's defense system - proliferation of lymphocytes, immune response → WHITE PULP.

THORACIC DUCT

The thoracic duct is the main trunk of the lymphatic vessel system. It lies below the diaphragm and is derived from the chyle cisterna, located on the right side of the aorta. The thoracic duct can be divided into the following portions:

- a short abdominal part, in front of L1
- a long thoracic part
- a short cervical part, in front of C7
- the arch of thoracic duct

and it opens into the left venous angle

The thoracic duct conveys lymph from the entire lower half of the body as well as regions on the upper left side of the body. It receives the following tributaries:

- truncus lumbalis dx. et sim.
- truncus intestinalis
- cisterna chyli
- pars abdominalis, thoracica, cervicalis
- truncus intercostalis dx. et sim.
- truncus jugularis sin.
- truncus subclavius sin.
- truncus bronchomediastinalis sin.

RIGHT LYMPHATIC DUCT

The right lymphatic duct drains regions of the upper right side of the body and opens into the right venous angle.

It receives:

- truncus jugularis dx.
- truncus subclavius dx.
- truncus bronchomediastinalis dx.

70. The lymphatic vessels and nodes of the head and neck

- nll. occipitales spf. et prof. - located at the border of the trapezius receive lymph from the occiput and neck
- nll. retroauriculares / mastoideus - receive lymph from parts of the ear and scalp
- nll. parotidei spf. et prof. -
  - superficial: lying on the parotid fascia

• deep: in the underlying fascia

↳ both receive lymph from the parotid gland, parts of the eyelids, external acoustic meatus and external nose.

These three groups of lymph nodes share a common drainage pathway to the deep cervical lymph nodes.

- nll. submentales - drain the floor of the oral cavity, tip of the tongue, and lower lip.

- nll. submandibulari - are located between the mandible and submandibular gland. These receive drainage directly from the medial angle of the eye, cheek, nose, lips, gingiva, and parts of the tongue. They drain into the deep cervical lymph nodes.

↳ facial nodes

↳ lingual nodes

NECK

- nll. cervicales anteriores spf. et prof.

• superficial: lying along the anterior jugular vein

• deep: can be divided into various subgroups by cervical viscera. All anterior lymph nodes ultimately drain into the deep cervical lymph nodes.

- nll. cervicales laterales spf. et prof.

a) nll. jugulares interni - nl. tonsillaris (Wood)
nl. jugulodigastricus (Küttner)
nl. jugulomohyoideus

b) nll. comitantes n. accessorii (CN. XI)

c) nll. supraclaviculares (Winchow)

71. The lymphatic vessels and nodes of the upper extremity

UPPER EXTREMITY

Superficial vessels - collectores laterales
collectores mediales
collectores anteriores (medii)

Superficial lymphatic vessels arise from lymphatic plexuses in the skin of the fingers, palm, and dorsum of the hand and ascend mostly with the superficial veins.

↳ drain into nll. cubitales spf. - located proximal to the medial epicondyle.

Deep vessels - rancus lymphaticus palmaris spf. et prof. - deep lymphatic vessels are less numerous than superficial vessels and accompany the major deep veins in the upper limb

↳ drain into nll. cubitales prof.

Nll. axillares: based on the anatomic nomenclature they can be divided into:

- nll. axillares centrales
- nll. axillares laterales
- nll. axillares pectorales - at the inferior border of the pectoralis minor
- nll. axillares subscapulares

- nll. axillares apicales (infraclaviculares) - at the superior border of the pectoralis minor.

They drain into truncus subclavius.

7.2. The lymphatic vessels and nodes of the thorax

- nll. pulmonales → TRUNCUS BRONCHOMEDIASTINALIS

• superficial: lies deep to the visceral pleura and drains the lung parenchyma and visceral pleura

• deep: submucosa of the bronchi and in the peribronchial connective tissue.

- nll. bronchopulmonales - in the region of the lung hilum
- nll. bronchiales
- nll. tracheobronchiales superiores et inferiores
  • superiores: superior to the bifurcation of the trachea and main bronchi
  • inferiores: inferior to the bifurcation of the trachea and main bronchi

Note: Many, but not all, of the lymphatics from the lower lobe of the lung, however, drain to the right superior tracheobronchial nodes.

- nll. tracheales
- nll. mediastinales anteriores: lie anterior to the aortic arch and receives lymph from the adjacent structures.
- nll. mediastinales posteriores: lie in the posterior part of the mediastinum.
- nll. phrenici superiores: are located at the large openings in the diaphragm and receive lymph from the diaphragm and liver
- nll. parasternales: lie on the inner aspect of the thoracic wall, lying along the internal thoracic vessels
- nll. intercostales: lie in the posterior portions of the intercostal spaces and receive lymph from the pleura and intercostal spaces.

→ DRAINAGE OF THE BREAST

The lymphatic drainage of the breast is important because of its role in the metastasis of cancer cells. Lymph passes from the nipple, areola, and lobules of the gland to the subareolar lymphatic plexus. From this plexus:

• Most lymph (>75%), especially from the lateral breast quadrants, drains to the axillary lymph nodes, initially to pectoral nodes for the most part. Some lymph may drain directly to other axillary nodes or even interpectoral, deltopectoral, supraclavicular, or inferior deep cervical nodes.

• Most of the remaining lymph, particularly from the medial breast quadrants, drains to the parasternal lymph nodes, whereas lymph from the inferior quadrants may pass deeply to abdominal lymph nodes.

1. Lateral quadrants - nll. axillares laterales, subscapulares and centrales
2. Medial quadrants - nll. parasternales
3. The center of the breast - nll. interpectorales - nll. infraclaviculares and supraclaviculares.
4. The epigastric pathway - along a. epigastrica inf. - anterior mediastinal and hepatic nodes.
5. The intercostal pathway - nll. intercostales.

7.3. The lymphatic vessels and nodes on the lower extremity

Superficial vessels - collectores mediales
- collectores laterales
- collectores posteriores

The superficial lymphatic vessels converge on and accompany the saphenous veins and their tributaries. The lymphatic vessels accompanying the great saphenous vein end in the vertical group of superficial inguinal lymph nodes

- nll. inguinales spf. - located in the subcutaneous adipose tissue of the inguinal region. They receive lymph from the superficial vessels of the leg as well as the anus, perineum and external genitalia.

The lymphatic vessels accompanying the small saphenous vein enter the popliteal lymph nodes, which surround the popliteal vein in the fat of the popliteal fossa.

- nll. poplitei
  - superficial: lie at the proximal end of the small saphenous vein
  - deep: along the popliteal artery.

Deep lymphatic vessels from the leg accompany deep veins and also enter the popliteal lymph node. Most lymph from these nodes ascends through deep lymphatic vessels to the deep inguinal lymph nodes.

- nll. inguinales prof. - lie deep to the fascia lata and receive lymph from the deep vessels of the leg. The uppermost lymph node belonging to this group, the Rosenmüller's node (proximal node), can be very large and located in the femoral canal.

These nodes drain to nodi lymphatici iliaci externi.

7.4. The lymphatic vessels and nodes of the abdomen and pelvis

ABDOMEN

- nll. coelici - lie around the celiac trunk
  - gastrici dx. et sin - lie along the lesser curvature of the stomach
  - gastroepiploici dx et sin - lie along the greater curvature of the stomach
  - pylorici - lie behind the pylorus

- hepatici - located near the porta hepatis
- pancreatoduodenales sup. et inf. - lie between pancreas and duodenum
- pancreatici sup. et inf. - are annanged along the superion and inferion borders of the pancreas
- lienales - lie at the splenic hilum

- nll. mesenterici - are situated along the root of the mesentery and drain via the celiac nodes
- nll. colici - along the ileocolic artery
- nll. mesenterici inferiores - lie along the inferion mesenteric artery and receive lymph from the descending colon, sigmoid colon and rectum.

↳ all these drain to truncus intestinalis

PELVIS

- nll. iliaci externi - surround the external iliac vessels
- nll. iliaci interni - paravesicales - groups around
  - paravaginales - lying adjacent to the vagina and draining part of it.
  - parauterine - adjacent to the uterus and mostly draining the cervix of uterus
- nll. sacrales
- nll. iliaci communes
- nll. lumbales

S. Gl. thyroidea, parathyroidea, thymus

THYROID GLAND

It consists of two conical, lateral lobes, the right lobe and left lobe which lie on either side of the larynx and trachea and are connected near their base by the isthmus of the thyroid gland.

The size and weight of the thyroid ranges from 2-3 g in the newborn to 18-60 g in the adult. Each lobe is 4-8 cm long, 2-4 cm wide and 1,5-2,5 cm thick in the middle.

The upper poles of the lobes extend as far as the oblique line of the thyroid cartilage and the lower poles to the fourth of fifth tracheal ring.

Normally measuring 1,5-2,0 cm wide and 0,5-1,5 cm thick, the isthmus varies in size and shape or may even be absent altogether. A long projection extends either from its cranial border or from that of one of the lobes, usually the right lobe, and ascends toward the hyoid bone. It is known as pyramidal lobe.

The thyroid gland is surrounded by a strong fibrous capsule consisting of two layers. The connective tissue internal capsule is thin and adheres closely to the

parenchyma of the gland.

The external capsule is toughen and is considered part of the pretracheal layer of the cervical fascia.

PARATHYROID GLANDS

The four parathyroid glands are lentil-shaped gland is roughly the size of a grain of wheat. They are nestled against the posterior aspect of the lateral lobes of the thyroid gland, situated between the two layers of the fibrous capsule. The paired superior parathyroid glands are located at the level of the caudal margin of the cricoid cartilage. The paired inferior parathyroid glands are located along the base of the lateral lobes at the level of the third and fourth tracheal cartilages.

THYMUS

The thymus is the principal lymphoid organ of the T-cell system and thus plays a central role in regulating the immune system function. The thymus is composed of two lobes, usually of unequal size, which may be partially fused or not at all. It lies behind the sternum in the superior mediastinum in front of the great vessels and over the pericardium.

In the neonate weights 11-13g. During the first three years of life its weight increases to about 23g. The thymus reaches its greatest size during puberty, weighing between 35 and 50g.

In the adult, the thymus is present only as a functional thymic remnant.

Its function concerns differentiation of lymphocytes in the immunocompetent T-lymphocytes, maintenance of necessary amount of lymphocytes in blood circulation and in peripheral tissue and maintenance of the the immune system.

76. Gl. suprarenales, paraganglia

The suprarenal (adrenal) glands are located between the superomedial aspects of the kidneys and the diaphragm, where they are surrounded by connective tissue containing considerable perinephric fat. The major attachment of the glands is to the diaphragmatic crura.

The shape and relations of the suprarenal glands differ on the two sides. The pyramidal right gland is more apical (situated over the superior pole) relative to the left kidney, lies anterolateral to the right crus of the diaphragm, and makes contact with the IVC anteromedially and the liver anterolaterally. The crescent-shaped left gland is medial to the superior half of the left kidney and is related to the spleen, stomach, pancreas, and the left crus of the diaphragm.

Each gland has a hilum, where the veins and lymphatic vessels exit the gland, whereas arteries and nerves enter the glands at multiple sites. The medial borders of the suprarenal glands are 4-5 cm apart. In this area, from right to left, are the IVC, right crus of the diaphragm, celiac ganglion, celiac trunk, SMA,

and the left crus of the diaphragm.

The adrenal glands project toward the posterior wall of the abdomen at the height of the necks of the 11th and 12th ribs.

Each suprarenal gland has two parts: the suprarenal cortex and suprarenal medulla

- suprarenal cortex: secretes corticosteroids and androgens
- suprarenal medulla: secretes catecholamines (mostly epinephrine) into the bloodstream in response to signals from presynaptic neurons.

PARAGANGLIA - are small groups of cells connected with the ganglia of the sympathetic trunk and the ganglia of the celiac, renal, suprarenal, aortic plexuses. They are concentrated near the suprarenal glands and essentially function the same way as the suprarenal medulla.