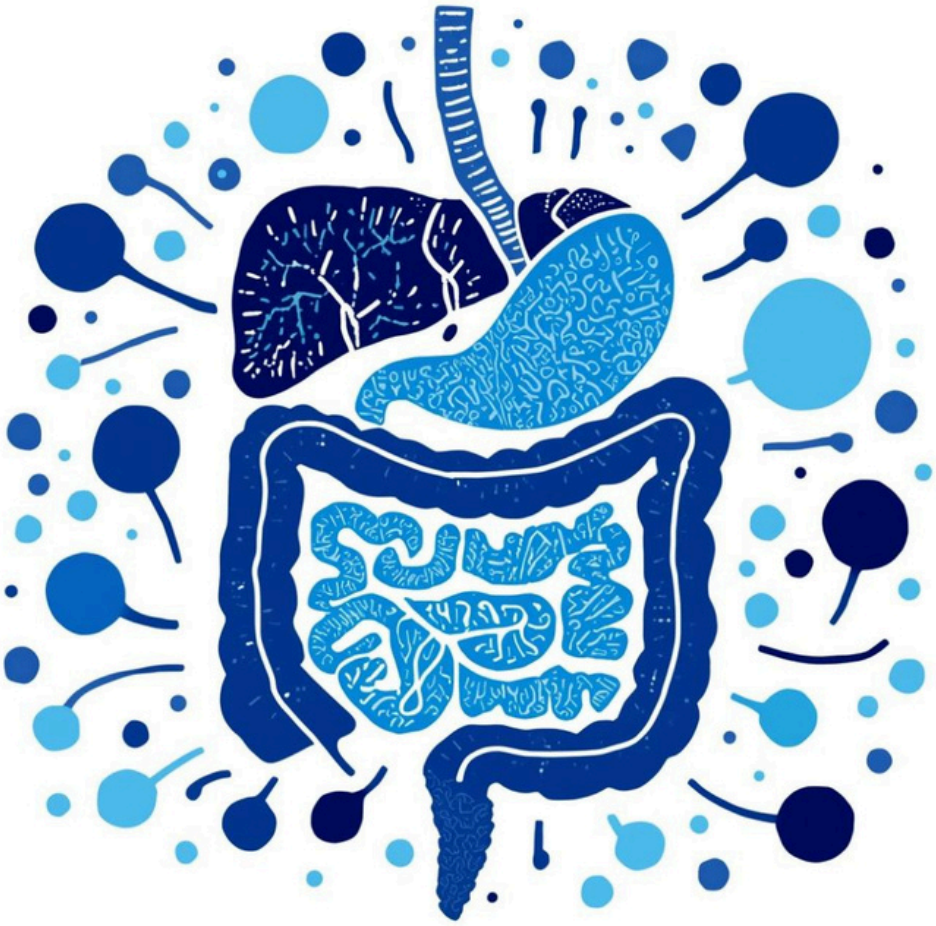
Anatomy



Second Year Students
UJ-GIG GI Booklet

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The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

Oral Cavity & Salivary Glands

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[Overview]

➔ **Outline:**

1) **The Mouth**
- Lips
- Mouth Cavity
- Teeth
- Tongue

2) **Salivary Glands**
- Parotid Gland
- Sublingual Gland
- Submandibular Gland

[The Mouth]

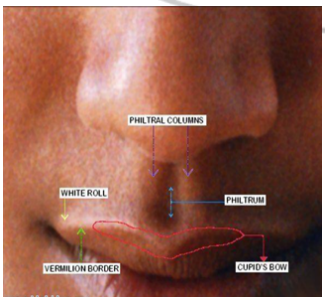
It is constituted of the:
1. Lips
2. Mouth Cavity
3. Teeth
4. Tongue

[The Lips]

- Two fleshy folds surround the oral orifice
- Its outer surface is covered by skin, while the mucus membrane lines the inner surface

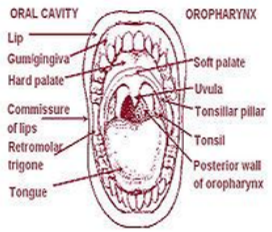
➔ **Core composition:**
- Orbicularis orris muscle – primarily
- Radiating facial muscles
- Labial blood vessels and nerves
- Connective tissue
- Many small salivary glands

➔ **Other structures:**
- Philtrum:
  - Shallow vertical groove in the midline on the outer surface of the upper lip
- Labial Frenulum:
  - Mucous membrane folds that connect the inner lips to the gums



[The Mouth Cavity]

➔ **Boundaries:**
- It extends from the lips to the pharynx
- The entrance into the pharynx is called the oropharyngeal isthmus, which is formed on each side by the palatoglossal fold



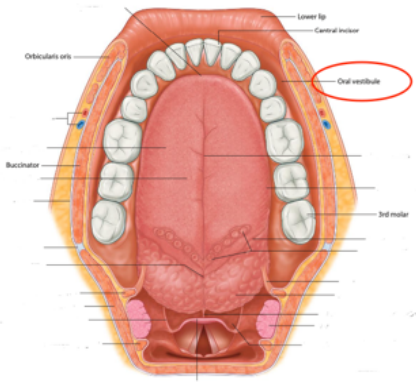
➔ **Division:**
- Vestibule
- Mouth Proper

1) Vestibule:

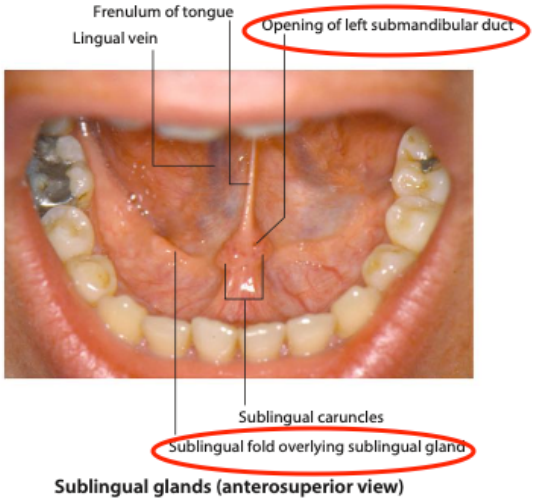
a. Location:
   i. Externally lies between the lips and cheeks
   ii. Internally between the gums and teeth

b. Communication:
   i. The slit-like space communicates with the exterior through the oral fissure between the lips
   ii. When the jaw is closed, it communicates with the mouth proper behind the third molar tooth

c. Walls:
   i. It's limited above and below by the reflection of the mucus membrane from the lips and cheeks to the gums
   ii. The lateral wall is formed by the cheek, which is made up of the buccinator muscle and is lined with the mucous membrane



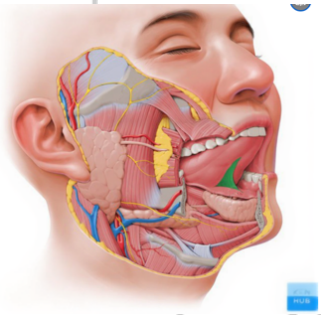
d. Function:
   i. The buccinator muscle's tone and that of the muscles of the lips keep the walls of the vestibule in contact with one another
e. Structure:
   i. The parotid duct opens on a small papilla into the vestibule opposite the upper second molar tooth



Sublingual glands (anterosuperior view)

2) Mouth Proper

- It has a roof and a floor
  a. Roof:
     i. Formed by the hard palate (front) and soft palate (back)
  b. Floor:
     i. Formed largely by the anterior 2/3 of the tongue and by the reflection of the mucous membrane from the sides of the tongue to the gum of the mandible
     ii. Key structures:



1. Frenulum of the tongue: midline fold tethering the tongue to the floor
2. Plica Fimbriata: fringed fold of mucous membrane lateral to the frenulum

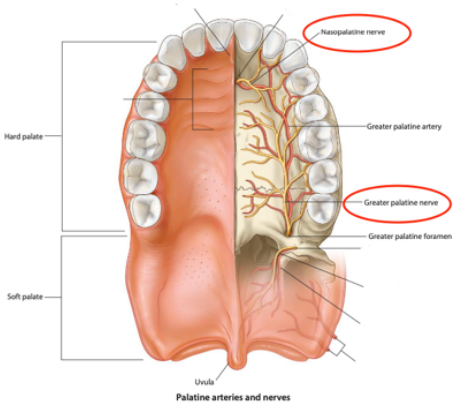
  c. Openings:
     i. Submandibular gland: its duct opens onto the floor of the mouth on the summit of a small papilla on either side of the frenulum of the tongue
     ii. Sublingual gland: projects up into the mouth, producing a low fold of mucous membrane, the sublingual fold
     iii. Numerous ducts of the gland open at the summit of the fold

- In the vestibule, the mucous membrane is tethered to the buccinator muscle by elastic fibers in the submucosa to prevent a redundant fold of mucous membrane from being bitten between the teeth when the jaws are closed

- The mucous membrane of the gingiva or gum is strongly attached to the alveolar periosteum

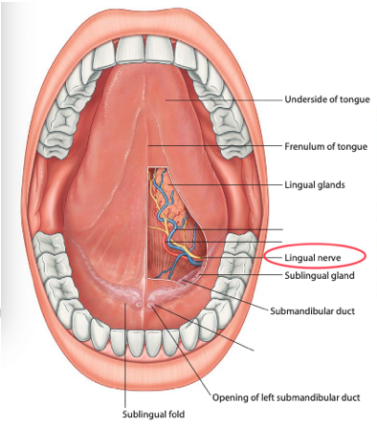
➔ **Sensory Innervation of the Mouth:**

- Roof:
  - The greater palatine and nasopalatine nerves from the maxillary division of the Trigeminal nerve



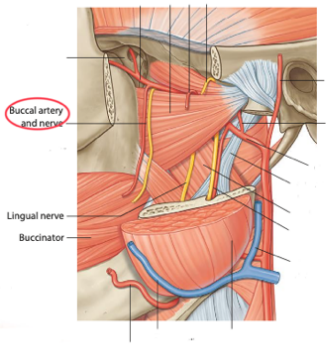
Palatine arteries and nerves

- Floor:
  - The lingual nerve (common sensation), a branch of the mandibular division of the trigeminal nerve
  - The taste fibers travel in the chorda tympani nerve, a branch of the facial nerve



Inferior surface of tongue and floor of oral cavity

- Cheek:
  - The buccal nerve, a branch of the mandibular nerve (vs. the buccinator muscle, which is innervated by the buccal branch of the facial nerve)



Nerves and vessels of the infratemporal fossa

[The Teeth]

-The gingivae (gums) are specialized regions of the oral mucosa that surround the teeth and cover adjacent regions of the alveolar bones

➔ **Types of teeth:**

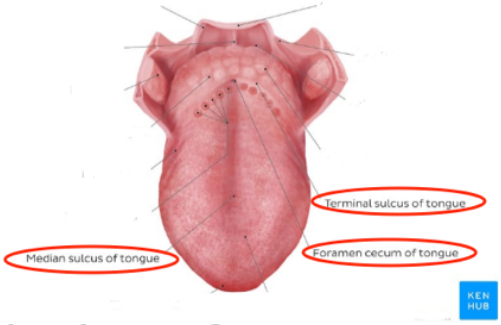
1. Deciduous Teeth
   a. There are 20 deciduous teeth, per jaw, we have:
      i. 4 Incisors
      ii. 2 Canines
      iii. 4 Molars
   b. They begin to erupt about 6 months after birth and have all erupted by the end of 2 years
   c. The teeth of the lower jaw usually appear before those of the upper jaw
2. Permanent Teeth
   a. There are 32 permanent teeth, per jaw, we have:
      i. 4 Incisors
      ii. 2 Canines
      iii. 4 premolers
      iv. 6 Molars
   b. They begin to erupt at 6 years of age
   c. The last tooth to erupt is the third molar, which may happen between the ages of 17 and 30
   d. The teeth of the lower jaw appear before those of the upper jaw

[The Tongue]

- It's a mass of striated muscle covered with a mucous membrane
- It's divided into right and left halves by a median fibrous septum
- The muscles attach the tongue to the styloid process and the soft palate above

➔ **The Mucous Membrane of the Tongue and Papillae:**

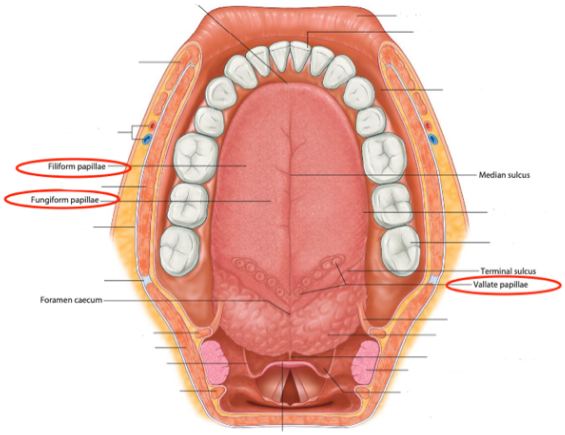
- Dorsal Surface – Upper surface:
  - **Division**: it's divided into an anterior 2/3 and posterior 1/3 by a V-shaped sulcus terminalis
  - **Landmark**: the apex of this sulcus points backwards and contains the foramen cecum, which is an embryological remnant marking the upper end of the thyroglossal duct



  - **Papillae**:
    - Anterior 2/3:
      - Filiform papillae
      - Fungiform papillae
      - Vallate (circumvallate) papillae

Note: Although the circumvallate (vallate) papillae are located anterior to the sulcus terminalis, they are embryologically derived from the posterior one-third of the tongue and are therefore innervated by the glossopharyngeal nerve (CN IX).

- Posterior 2/3:
  - NO papillae
  - Its irregular surface is due to the underlying lymphatic tissue called the lingual tonsil

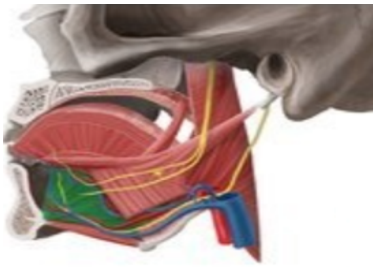


- Ventral surface - Inferior Surface:
  - The mucus membrane is smooth and reflected onto the floor of the mouth
  - **Structures**:
    - Frenulum of the tongue:
      - Midline fold that connects the tongue to the floor of the mouth
    - Deep lingual vein:
      - Visible through the mucous membrane just lateral to the frenulum
    - Plica fimbriata:
      - a fringed fold of mucous membrane located lateral to the deep lingual vein

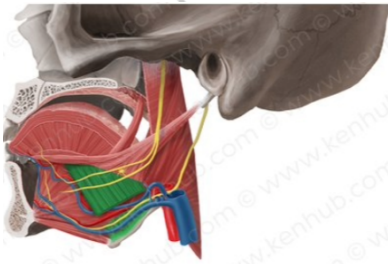
➔ **The Muscles of the Tongue:**

1. Intrinsic Muscles
   a. **Location**: confined to the tongue and are not attached to bone
   b. **Fiber orientation**: consists of longitudinal, transverse, and vertical fibers
   c. **Nerve supply**: Hypoglossal nerve
   d. **Action**: Alter the shape of the tongue

2. Extrinsic Muscles:
   a. **Location**: attach the tongue to the bones and soft palate
   b. **Primary muscles and functions:**
      i. Genioglossus:
         1. **Origin**: superior genial spine of the mandible
         2. **Action:** protrudes the apex of the tongue

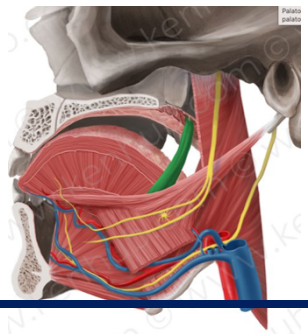


      ii. Hyoglossus:
         1. **Origin**: body and greater cornu of the hyoid bone
         2. **Action:** depresses the tongue



      iii. Styloglossus:
         1. **Origin**: styloid process of the temporal bone
         2. **Action:** retracts and elevates the tongue

      iv. Palatoglossus:
         1. **Origin**: palatine aponeurosis
         2. **Action:** elevates the posterior tongue and narrows the oropharyngeal isthmus



c. **Insertion**:
   i. All of them interdigitate with each other and insert into the substance of the tongue
   ii. The palatoglossus inserts at the lateral aspect of the tongue

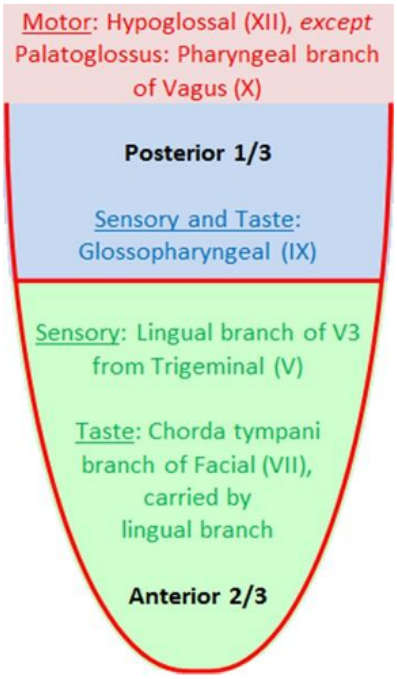
d. **Nerve supply**:
   i. Hypoglossus nerve, except for palatoglossus, which is innervated by vagus nerve

➔ **Movements of the Tongue:**

- Protrusion:
  - Genioglossus muscles on both sides are acting together
- Retraction:
  - Styloglossus and hyoglossus muscles on both sides are acting together
- Depression:
  - Hyoglossus muscles on both sides are acting together
- Retraction and elevation of the posterior third:
  - Styloglossus and palatoglossus muscles on both sides are acting together
- Shape changes:
  - Intrinsic muscles

➔ **Sensory Innervation + Blood Supply + Lymph Drainage**

- Sensory Innervation:
  - **Anterior 2/3**:
    - Lingual nerve branch of the mandibular division of the trigeminal nerve – general sensation
    - Chorda tympani, branch of the facial nerve – taste sensation
  - **Posterior 1/3**:
    - Glossopharyngeal nerve – general sensation and taste
- Blood Supply:
  - **Arteries**:
    - The lingual artery
    - The tonsillar branch of the facial artery
    - The ascending pharyngeal artery
  - **Veins**:
    - The veins drain into the internal jugular vein
- Lymph Drainage:
  - **Tip**:
    - Submental lymph nodes
  - **Sides of the Anterior 2/3**:
    - Submandibular and Deep Cervical lymph nodes
  - **Posterior 1/3**:
    - Deep Cervical lymph nodes



[The Salivary Glands]

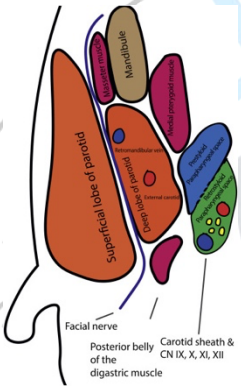
It is constituted of:

1. Parotid gland
2. Submandibular gland
3. Sublingual gland

[The Parotid Gland]

➔ **Type/Composition + Structure:**

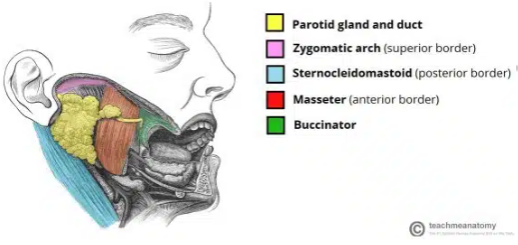
- Largest salivary gland; composed mostly of serous acini
- The internal structure is divided into superficial and deep lobes by the facial nerve



Note: Unlike the other major salivary glands, the parotid gland is enclosed in a thick fascial capsule derived from the deep cervical fascia, which limits expansion and explains the severe pain seen in parotid inflammation (e.g., mumps).

➔ **Anatomical Relations:**

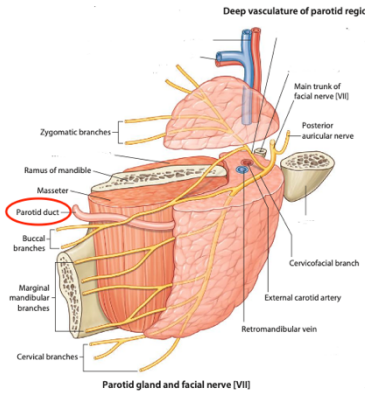
- Lies in the parotid bed that is formed by:
  - **Posteriorly**:
    - Sternocleidomastoid muscle
  - **Anteriorly**:
    - Ramus of the mandible
  - **Superiorly**:
    - External acoustic meatus and posterior aspect of the zygomatic arch



- Structures within (the gland encloses):
  - The external carotid artery
  - The retromandibular vein
  - The origin of the extracranial part of the facial nerve

➔ **Parotid Duct**

- Emerges from the anterior border of the gland
- Passes forwards over the lateral surface of the masseter
- Enters the vestibule of the mouth upon a small papilla opposite the upper second molar tooth



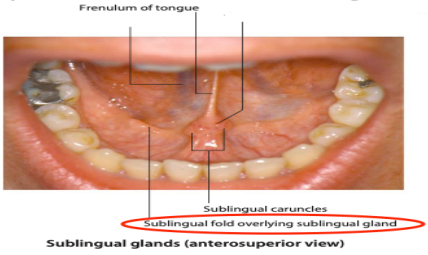
➔ **Innervation:**

- Parasympathetic secretomotor supply arises from the glossopharyngeal nerve
- The nerves reach the gland via the tympanic branch, lesser petrosal nerve, otic ganglion, and auricotemporal nerve

[The Sublingual Gland]

➔ **Type/Composition + Location:**

- Has both serous and mucous acini, with mucous predominating
- It lies beneath the mucous membrane (forming the sublingual fold) of the floor of the mouth, close to the frenulum of the tongue



➔ **Sublingual Duct:**

- Has multiple sublingual ducts (8-20 in number) that open into the mouth at the summit of the sublingual fold

➔ **Innervation:**

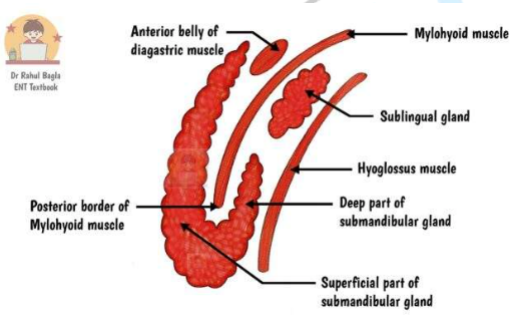
- Parasympathetic secretomotor supply is from the facial nerve via the chorda tympani and the submandibular ganglion

- Postganglionic fibers pass directly to the gland

[The Submandibular Gland]

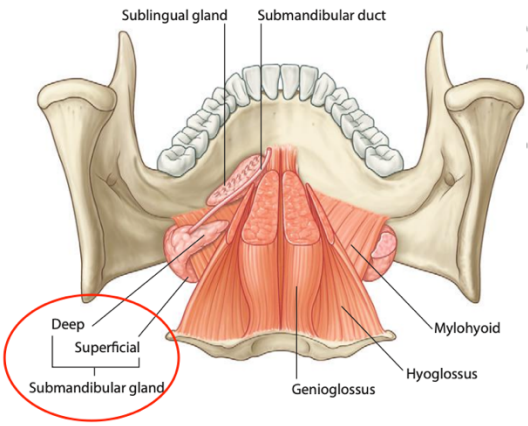
➔ Type/Composition + Structure:

- Consists of a mixture of serous and mucous acini
- It's divided into superficial and deep parts by the mylohyoid muscle
  - The deep part lies beneath the mucous membrane of the mouth on the side of the tongue



➔ Anatomical Relations:

- It lies beneath the lower border of the body of the mandible
- The superficial part – the larger arm lies:
  - directed forward in the horizontal plane below the mylohyoid outside the oral cavity
  - directly against a shallow impression on the medial side of the mandible – the submandibular fossa – inferior to the mylohyoid line
- The deep part – the smaller arm:
  - loops around the posterior margin of the mylohyoid muscle to enter and lie within the floor of the oral cavity
  - lies lateral to the root of the tongue on the lateral surface of the hypoglossal muscle

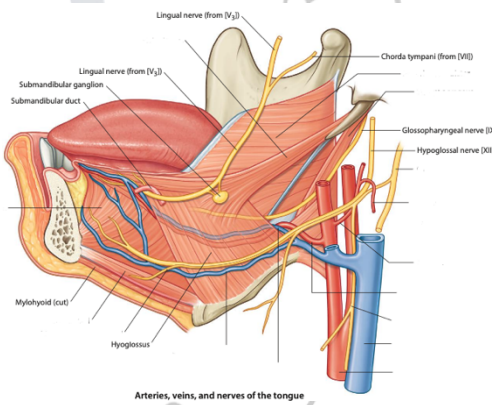


➔ Submandibular Duct:

- Emerges from the anterior end of the deep part of the gland
- Runs forward beneath the mucous membrane of the mouth
- Opens into the mouth on a small papilla at the side of the frenulum of the tongue
- The lingual nerve loops under the submandibular duct, crossing first the lateral side and then the medial side of the duct, as the nerve descends anteromedially through the floor of the oral cavity and then ascends into the tongue

➔ Innervation:

- Parasympathetic secretomotor supply is from the facial nerve via the chorda tympani and the submandibular ganglion
- Postganglionic fibers pass directly to the gland



Arteries, veins, and nerves of the tongue

The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

Palate & Pharynx

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[Overview]

➔ **Outline:**

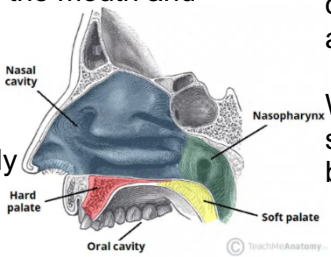
1) **Palate**
   - → Hard Palate Anatomy
   - → Soft Palate Anatomy
   - → Movements of the Soft Palate
   - → Nerve & Blood Supply of the Palate
   - → Lymph Drainage of the Palate
   - → Palatine Tonsils

2) **Pharynx**
   - → Anatomy of Pharynx
   - → Interior of the Pharynx
   - → Sensory Innervation, Blood Supply, and Lymph Drainage of the Pharynx
   - → The Process of Swallowing (Deglutition)
   - → Waldeyer's Ring of Lymphoid Tissue

[Palate]

- The palate forms both the roof of the mouth and the floor of the nasal cavity.

- It is divided into two parts:
  - the hard palate anteriorly
  - and the soft palate posteriorly



Hard Palate Anatomy

The hard palate is comprised of bone and is immobile.
It is formed by the palatine processes of the maxillae and the horizontal plates of the palatine bones. It is continuous posteriorly with the soft palate.

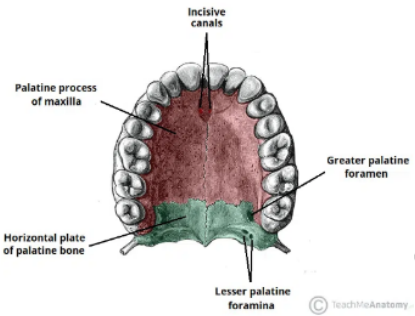


Fig 2
The hard palate is formed by the contributions from the maxilla and palatine bones.

Soft Palate Anatomy

The soft palate is composed of mucous membrane, palatine aponeurosis, and muscles.

Anatomical relation:

- The soft palate is a mobile fold attached to the posterior border of the hard palate.
- Its free posterior border presents in the midline with a conical projection called the uvula.
- The soft palate is continuous at the sides with the lateral wall of the pharynx.

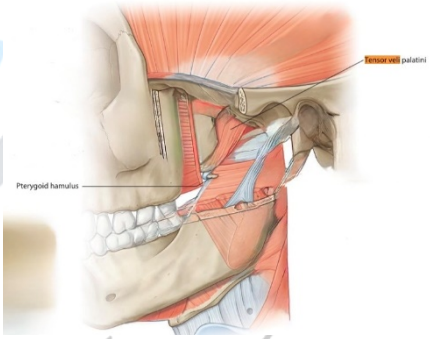
The mucous membrane covers the upper and lower surfaces of the soft palate.

The palatine aponeurosis is a fibrous sheet attached to the posterior border of the hard palate. It is **the expanded tendon of the tensor veli palatini muscle.**

The muscle fibers of the tensor veli palatini converge as they descend from their origin to form a narrow tendon, which turns medially around the pterygoid hamulus.

The tendon, together with the tendon of the opposite side, expands to form the palatine aponeurosis.

When the muscles of the two sides contract, the soft palate is tightened so that the soft palate may be moved upward or downward as a tense sheet

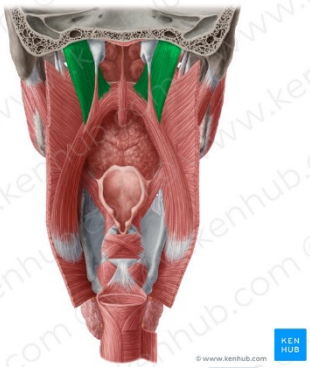


→ **The Muscles:**

1. Tensor veli palatini

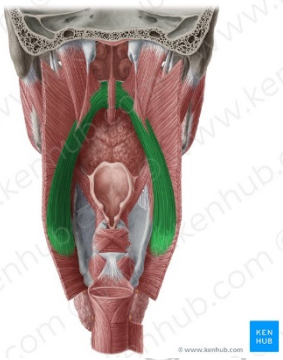
- Origin: spine of sphenoid, auditory tube
- Insertion: with the contralateral muscle forms the palatine aponeurosis
- Innervation: nerve to the medial pterygoid from the mandibular nerve
- Action: tenses soft palate

2. Levator veli palatini



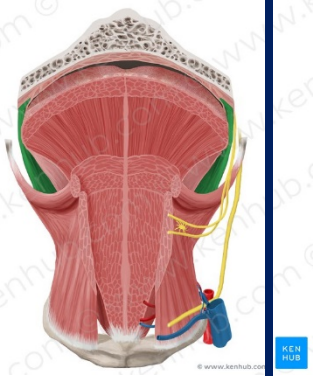
- Origin: petrous part of the temporal bone, auditory tube.
- Insertion: palatine aponeurosis
- Innervation: pharyngeal plexus
- Action: raises the soft palate

3. Palatopharyngeus



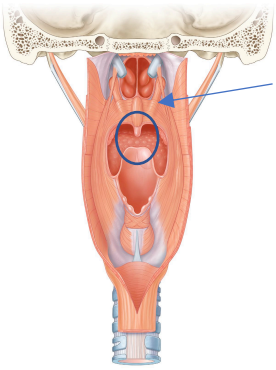
- Origin: palatine aponeurosis
- Insertion: posterior border of thyroid cartilage
- Innervation: pharyngeal plexus
- Action: elevates the wall of the pharynx, pulls the palatopharyngeal folds medially

4. Palatoglossus



- elevates posterior tongue and narrows the oropharyngeal isthmus; innervated by the pharyngeal plexus (CN X)

5. Musculus uvulae



- Origin: Posterior border of the hard palate
- Insertion: Mucous membrane of the uvula
- Innervation: Pharyngeal plexus
- Action: Elevates uvula

Notice how all muscles are innervated by the pharyngeal plexus which is part of the Vagus nerve EXCEPT TENSOR VELI PALATINI which is supplied by the medial pterygoid from mandibular nerve. Keep this in mind! And remember this is **motor** innervation!

Movements of the Soft Palate

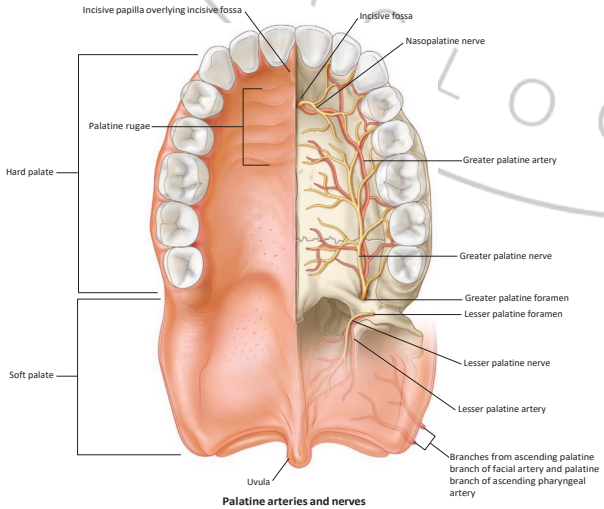
The soft palate either moves upwards and backwards to close the nasopharynx (such as during vomiting), or it moves downwards and forwards to raise the tension in the oral cavity (during mastication).

- The pharyngeal isthmus (the communicating channel between the nasal and oral parts of the pharynx) is closed by raising the soft palate.
- Closure occurs during the production of explosive consonants in speech.
- The soft palate is raised by the contraction of the levator veli palatini on each side.
- At the same time, the upper fibers of the superior constrictor muscle contract and pull the posterior pharyngeal wall forward.
- The palatopharyngeus muscles on both sides also contract so that the palatopharyngeal arches are pulled medially, like side curtains
- Through these means, the nasal part of the pharynx is closed off from the oral part.

Nerve & Blood Supply of the Palate

→ Nerve supply
To avoid any confusion, let's agree on something: When it comes to innervation, we have sensory and motor supplies, and they are not the same!

The nerves responsible for sensory innervation of the whole palate (soft and hard) are the maxillary nerve and its branches (the greater palatine nerve, which enters through the greater palatine foramen, the lesser palatine nerve, which enters through the lesser palatine foramen, and the nasopalatine nerve, which enters through the incisive foramen) and the glossopharyngeal nerve.



Palatine arteries and nerves

- Sensory nerve supply of soft palate:

  The sensory anterior part of the soft palate is innervated by the lesser palatine nerve, which is a branch of the maxillary division of the trigeminal nerve (CN V2). The posterior part, however, is innervated mainly by the pharyngeal branches of the glossopharyngeal nerve (CN IX).

- Sensory nerve supply of the hard palate:

  The nasopalatine and the greater palatine nerves, which are branches of the maxillary division of the trigeminal nerve (CN V2).

- Motor nerve supply of the soft palate:
  As mentioned earlier.

→ Blood Supply of the Palate

1. The greater palatine branch of the maxillary artery.
2. The ascending palatine branch of the facial artery.
3. The ascending pharyngeal artery arises from the external carotid artery.

Lymph Drainage of the Palate

Deep Cervical Lymph Nodes

The Palatine Tonsils

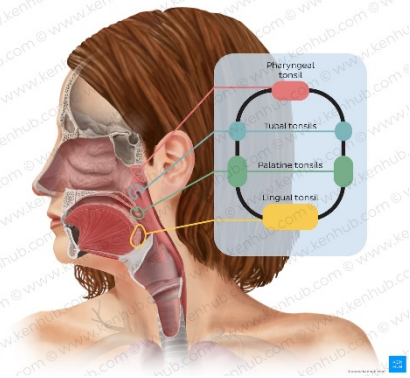
The palatine tonsils are masses of lymphoid tissue, which are located between the palatoglossal and palatopharyngeal arches.

- The palatoglossal arch is a fold of mucous membrane containing the palatoglossus muscle, which extends from the soft palate to the side of the tongue

  *The palatoglossal arch marks where the mouth becomes the pharynx.

- The palatopharyngeal arch is a fold of mucous membrane containing the palatopharyngeus muscle, and it is behind the palatoglossal arch. It runs downward and laterally to join the pharyngeal wall.

Palatine tonsils form part of the pharyngeal lymphoid ring (aka the Waldeyer's Ring of Lymphoid Tissue)! Check out the pic below and keep this in mind :)



Anatomical relations:
*Note: the following information needs imagination, so focus and read slowly.

*Another note: we are going to study the muscles mentioned in the pharynx section, just bear with me for now. You can read this page thoroughly now and come back again after we discuss the muscles if you feel overwhelmed.

- Each tonsil is covered by a mucous membrane, and its free <u>medial surface</u> projects into the pharynx.
- The surface is pitted by numerous small openings that lead into the tonsillar crypts (around 15-20 crypts).
- The tonsil is covered on its <u>lateral surface</u> by a fibrous capsule, which is separated from the superior constrictor muscle by loose areolar tissue. Within this tissue, the external palatine vein runs down from the soft palate to join the pharyngeal venous plexus.

- Lateral to the superior constrictor muscle lie:
  1. The styloglossus muscle,
  2. the loop of the facial artery,
  3. and the internal carotid artery.

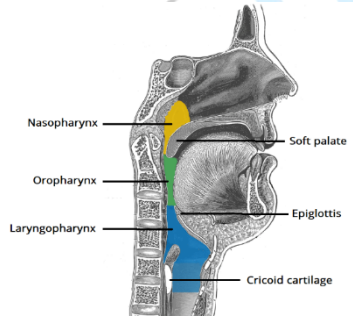
- The tonsil reaches its maximum size during early childhood, but after puberty, it diminishes considerably in size.

- <u>Blood supply of the palatine tonsils:</u> the tonsillar branch of the facial artery.
- <u>Venous drainage:</u> the veins pierce the superior constrictor muscle and join the external palatine, the pharyngeal, or the facial veins.
- <u>Lymph Drainage of the Tonsil:</u> the upper deep cervical lymph nodes, just below and behind the angle of the mandible

[Pharynx]

Anatomy of the Pharynx

- The pharynx extends from the base of the skull to the lower border of C6 vertebra, and it then continues as the esophagus.
- It lies behind the nasal cavity, the mouth, and the larynx.
- Based on its anterior relations, it consists of three regions:
  - **Nasopharynx** - posterior to the nasal cavity
  - **Oropharynx** - posterior to the oral cavity
  - **Laryngopharynx**- posterior to the larynx



- The pharynx has a musculomembranous wall, which is deficient anteriorly where it is replaced by the posterior openings into the nose (choanae), the opening into the mouth (oropharyngeal isthmus), and the inlet of the larynx (the inlet is bounded by the epiglottis).

- By means of the auditory tube, the mucous membrane is also continuous with that of the tympanic cavity.

Muscles of the Pharynx

Six pharynx muscles in total can be divided into two groups:

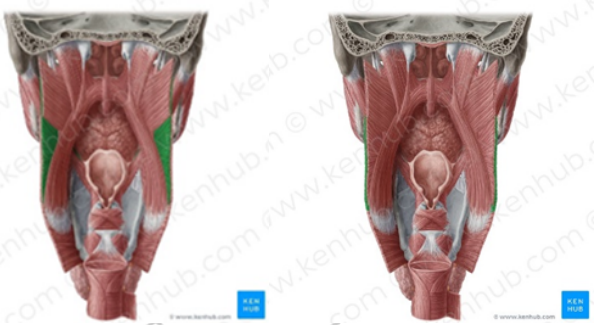
- **Pharyngeal constrictors**
  whose fibers run in a somewhat circular direction
  - Superior constrictor muscle
  - Middle constrictor muscle
  - Inferior constrictor muscle

- **Longitudinal muscles**
  whose fibers run in a somewhat longitudinal direction.
  - Salpingopharyngeus
  - Stylopharyngeus
  - Palatopharyngeus

- **Pharyngeal constrictors**

- The three constrictor muscles extend around the pharyngeal wall to be inserted into a fibrous band or raphe that extends from the pharyngeal tubercle on the basilar part of the occipital bone of the skull down to the esophagus.

- The three constrictor muscles overlap each other so that the middle constrictor lies on the outside of the lower part of the superior constrictor and the inferior constrictor lies outside the lower part of the middle constrictor (*check the diagrams below paying attention to the green color, you can zoom to see better, the first diagram shows the middle constrictor muscle and the second diagram shows the inferior constrictor).



1. Superior constrictor muscle

Origin: medial pterygoid plate, pterygoid hamulus, pterygomandibular ligament, mylohyoid line of mandible

Insertion: pharyngeal tubercle of occipital bone, raphe in midline posteriorly

Innervation: pharyngeal plexus

Action: aids the soft palate in closing off the nasal pharynx, propels the bolus downward.

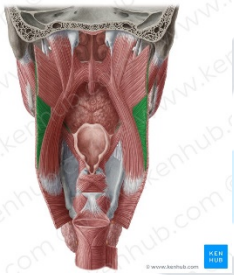
2. Middle constrictor muscle

Origin: lower part of stylohyoid ligament, lesser and greater cornu of the hyoid bone

Insertion: pharyngeal raphe

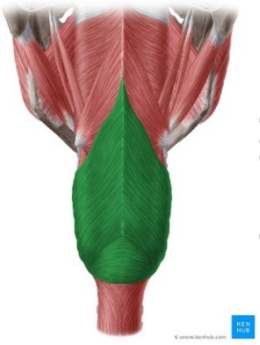
Innervation: pharyngeal plexus

Action: propels bolus downward



3. Inferior constrictor muscle

Origin: lamina of thyroid cartilage, cricoid cartilage

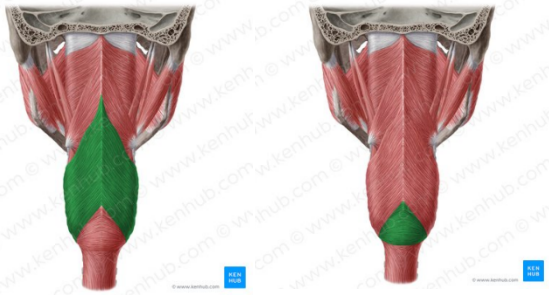


Insertion: Pharyngeal raphe

Innervation: Pharyngeal plexus

Action: Propels bolus downward

If you look closely at the inferior constrictor muscle in the previous picture, you will notice it consists of two parts! Check the images below:

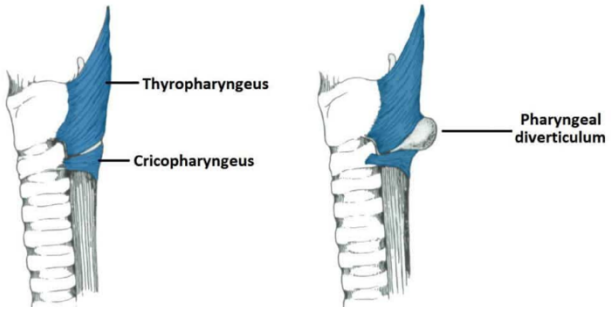


The inferior constrictor muscle consists of two parts: the thyropharyngeal part superiorly and the cricopharyngeal part inferiorly.

The cricopharyngeal part is the part we are concerned about; I want you to know that it arises from the cricoid cartilage, and the fibers pass horizontally around the lowest and narrowest part of the pharynx and act as a **sphincter** that is always closed (to prevent the passage of air) and opens only by stimulation of the bolus.

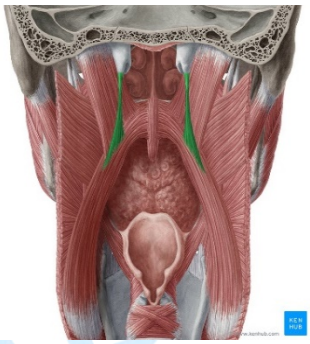
Killian's dehiscence is the area on the posterior pharyngeal wall between the upper propulsive part of the inferior constrictor and the lower sphincteric part, the cricopharyngeus.

Clinical Relevance: Pharyngeal Diverticulum (Zenker's diverticulum)
Normally, during **swallowing**, the thyropharyngeus contracts as the cricopharyngeus relaxes, allowing the bolus of food to be propelled into the oesophagus and preventing the intrapharyngeal pressure from rising.
If this coordinated relaxation of the cricopharyngeus does not occur, the intrapharyngeal pressure tends to rise, and the pharyngeal mucosa forms a **midline diverticulum** in the area between the thyropharyngeus and cricopharyngeus. Food can accumulate here, leading to dysphagia.



Longitudinal muscles:

1. **Salpingopharyngeus**



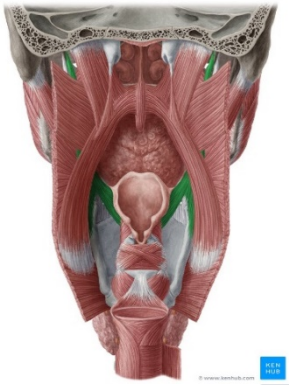
Origin: auditory tube

Insertion: blends with the palatopharyngeus

Innervation: pharyngeal plexus

Action: elevates the pharynx

2. **Stylopharyngeus**



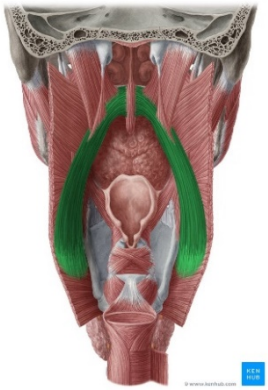
Origin: styloid process of the temporal bone

Insertion: posterior border of thyroid cartilage

Innervation: glossopharyngeal nerve (notice the only one innervated by the glossopharyngeal nerve)

Action: elevates the larynx during swallowing

3. **Palatopharyngeus**



Origin: Palatine aponeurosis

Insertion: Posterior border of thyroid cartilage

Innervation: Pharyngeal plexus

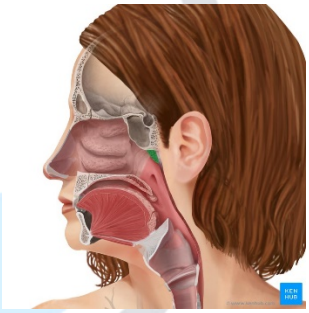
Action: Elevates the wall of the pharynx, pulls the palatopharyngeal arch medially

Interior of the Pharynx

→ Nasopharynx

It lies above the soft palate and behind the nasal cavities

- In the submucosa of the roof is a collection of lymphoid tissue called the pharyngeal tonsil (which is part of the Waldeyer's Ring of Lymphoid Tissue).



- The pharyngeal isthmus is the opening in the floor between the soft palate and the posterior pharyngeal wall (it's not the same as the oropharyngeal isthmus we mentioned earlier. Check the picture below)

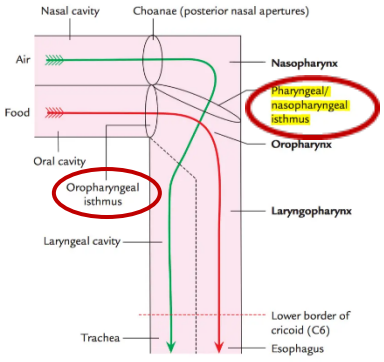
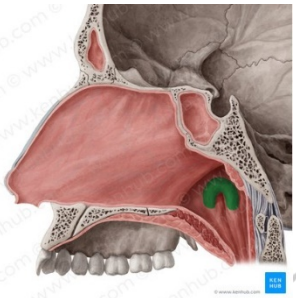
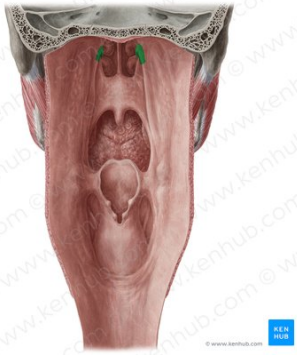


Fig. 14.2 Pathways for food (red arrow) and air (green arrow) through the pharynx.

- On the lateral wall is the opening of the auditory tube, the elevated ridge of which is called the tubal elevation (aka torus tubarius).





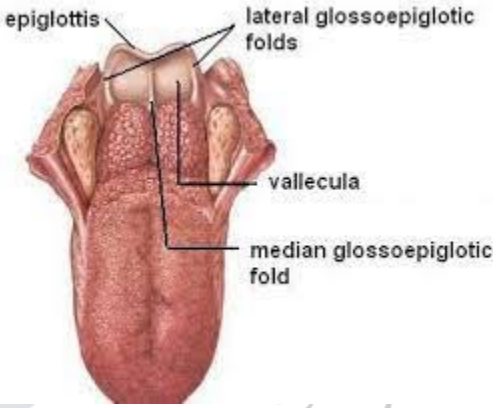
- The pharyngeal recess is a depression in the pharyngeal wall behind the tubal elevation

- The salpingopharyngeal fold is a vertical fold of mucous membrane covering the salpingopharyngeus muscle.

→Oropharynx

- It lies behind the oral cavity.
- The floor is formed by the posterior one-third of the tongue and the interval between the tongue and epiglottis.

- In the midline is the median glossoepiglottic fold, and on each side the lateral glossoepiglottic fold.
- The depression on each side of the median glossoepiglottic fold is called the vallecula



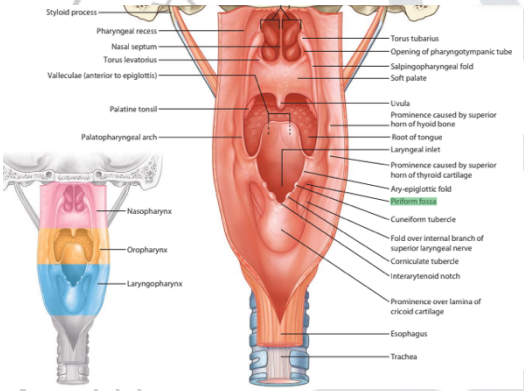
- On the lateral wall on each side are the palatoglossal and the palatopharyngeal arches or folds, and the palatine tonsils between them.

- The interval between the two palatoglossal arches is called the oropharyngeal isthmus and marks the boundary between the mouth and pharynx.

→Laryngopharynx

- It lies behind the opening into the larynx
- The lateral wall is formed by the thyroid cartilage and the thyrohyoid membrane

- The piriform fossa is a depression in the mucous membrane on each side of the laryngeal inlet

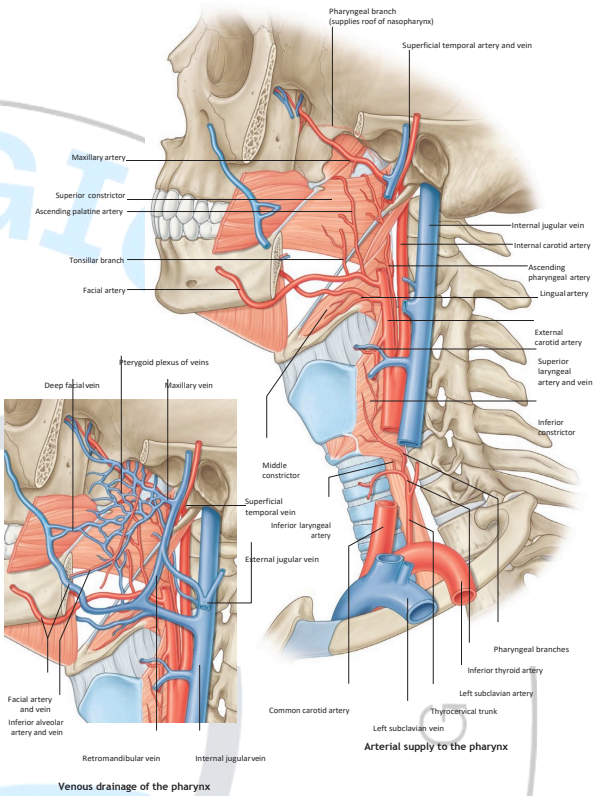


→ Lymph Drainage of the Pharynx

Directly into the deep cervical lymph nodes

OR

Indirectly via the retropharyngeal or paratracheal nodes into the deep cervical nodes.



Sensory Innervation, blood supply, and lymph drainage of the pharynx

→ Sensory Nerve Supply of the Pharyngeal Mucous Membrane

- Nasal pharynx: maxillary nerve (V2)
- Oral pharynx: glossopharyngeal nerve
- Laryngeal pharynx (around the entrance into the larynx): internal laryngeal branch of the vagus nerve

→ Blood Supply of the Pharynx

Ascending pharyngeal, tonsillar branches of facial arteries, and branches of maxillary and lingual arteries

The Process of Swallowing (Deglutition)

- Masticated food is formed into a ball or bolus on the dorsum of the tongue and voluntarily pushed upward and backward against the undersurface of the hard palate
- This is brought about by the contraction of the styloglossus muscles on both sides, which pull the root of the tongue upward and backward
- The palatoglossus muscles then squeeze the bolus backward into the pharynx.
- From this point onward, the process of swallowing becomes an involuntary act.
- The nasal part of the pharynx is now shut off from the oral part of the pharynx by the elevation of the soft palate.

- The pulling forward of the posterior wall of the pharynx by the upper fibers of the superior constrictor muscle, and the contraction of the palatopharyngeus muscles. This prevents the passage of food and drink into the nasal cavities

- The larynx and the laryngeal part of the pharynx are pulled upward by the contraction of the stylopharyngeus, salpingopharyngeus, thyrohyoid, and palatopharyngeus muscles.

- The main part of the larynx is thus elevated to the posterior surface of the epiglottis, and the entrance into the larynx is closed.

- The laryngeal entrance is made smaller by the approximation of the aryepiglottic folds, and the arytenoid cartilages are pulled forward by the contraction of the aryepiglottic, oblique arytenoid, and thyroarytenoid muscles.

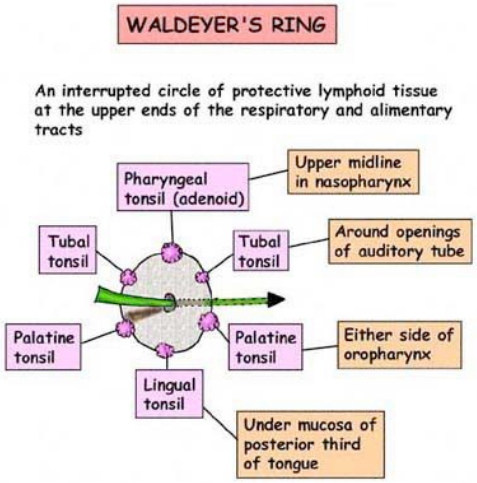
- The bolus moves downward over the epiglottis, the closed entrance into the larynx, and reaches the lower part of the pharynx as a result of the successive contraction of the superior, middle, and inferior constrictor muscles.

- Some of the food slides down the groove on either side of the entrance into the larynx, that is, down through the piriform fossae.

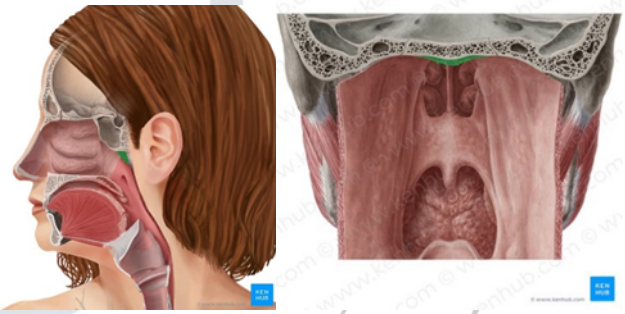
- Finally, the lower part of the pharyngeal wall (the cricopharyngeus muscle) relaxes, and the bolus enters the esophagus.

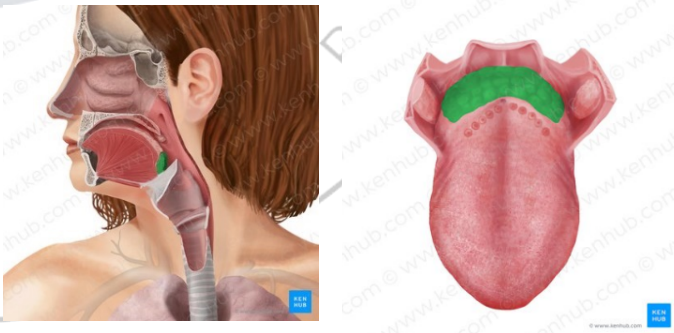
Waldeyer's Ring of Lymphoid Tissue

The lymphoid tissue that surrounds the opening into the respiratory and digestive systems forms a ring.



The pharyngeal tonsil in the roof of the nasopharynx forms the upper part(we already mentioned, look at the first and second pics), and the lingual tonsil on the posterior third of the tongue forms the lower part(third and fourth pics).





The lateral part of the ring is formed by the palatine tonsils (we already mentioned this) and tubal tonsils (lymphoid tissue around the opening of the auditory tube in the lateral wall of the nasopharynx)

The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

Inguinal Canal

Written by: Reem Abuhamdah

Edited by: Bdour Abdallat

Reviewed by: Amr Abdallah

[Overview]

Before starting, pay close attention to this lecture; its concepts are fundamental and will come up repeatedly in future years.

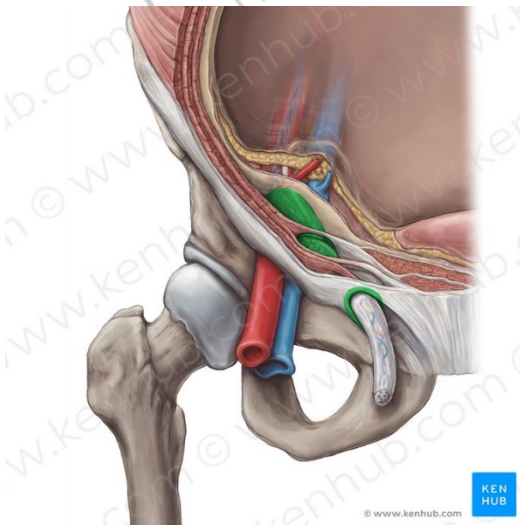
➔ **Outline of the Inguinal Canal. We will cover:**

1) **Inguinal canal**
- ➔ Quick review of the anterior abdominal wall
- ➔ Deep inguinal ring
- ➔ Superficial inguinal ring
- ➔ Walls of the inguinal canal
- ➔ Inguinal (Hesselbach's) triangle
- ➔ Contents of the inguinal canal
- ➔ Structures of the spermatic cord
- ➔ Inguinal hernia (direct vs indirect)

2) **Scrotum**
- ➔ Scrotal wall
- ➔ Scrotum contents
- ➔ Testes
- ➔ Structures inside the testis
- ➔ Blood supply to the testes
- ➔ Lymphatic drainage for testes
- ➔ Nerve supply to the testes

3) **Clinical conditions involving the scrotum and testes**
- ➔ Varicocele
- ➔ Congenital anomalies of the processus vaginalis
- ➔ Cryptorchidism
- ➔ Maldescent

[Inguinal canal]



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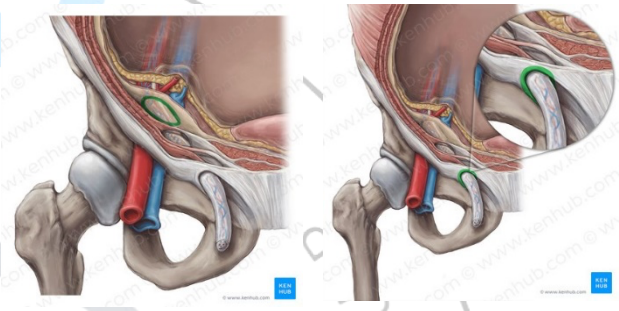
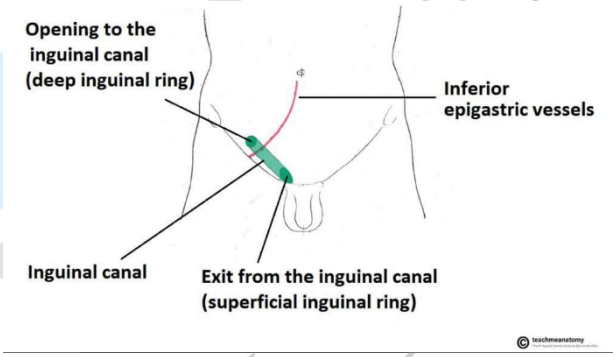
- It's called the inguinal canal because it lies parallel to and immediately above the <u>inguinal ligament,</u> which extends from the anterior superior iliac spine (ASIS) to the pubic tubercle.

- The inguinal canal is an oblique passage through the lower part of the anterior abdominal wall. Which extends from the deep inguinal ring (shown in the first picture) downward and medially to the superficial inguinal ring (shown in the second picture).



- It measures about 1 ½ inches or 4cm long in adults**.** *While in newborns, the deep ring lies almost directly posterior to the superficial ring!*

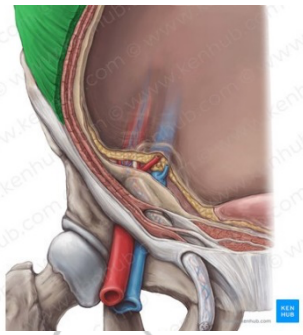


In this lecture, we are going to talk about different parts of this canal: from the deep inguinal ring to the superficial inguinal ring, its walls, and most importantly, its contents.

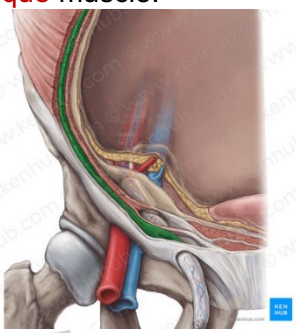
Quick review of the anterior abdominal wall

Before we start, I want to remind you of the 3 muscles of the anterior abdominal wall that will help us better understand what follows.
From the outside in: the external oblique muscle, the internal oblique muscle, and the transverse abdominis muscle.

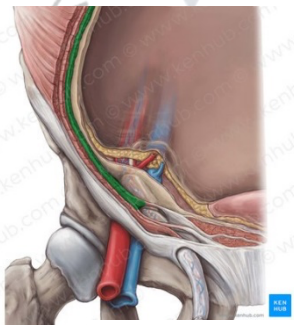
External oblique muscle:



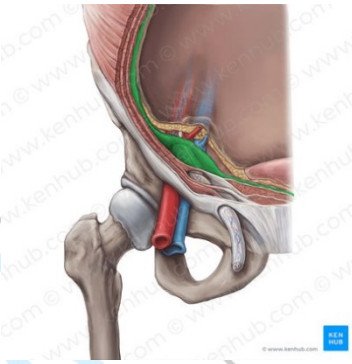
Internal oblique muscle:



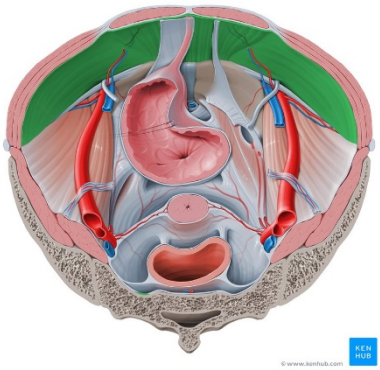
Transverse abdominis muscle:



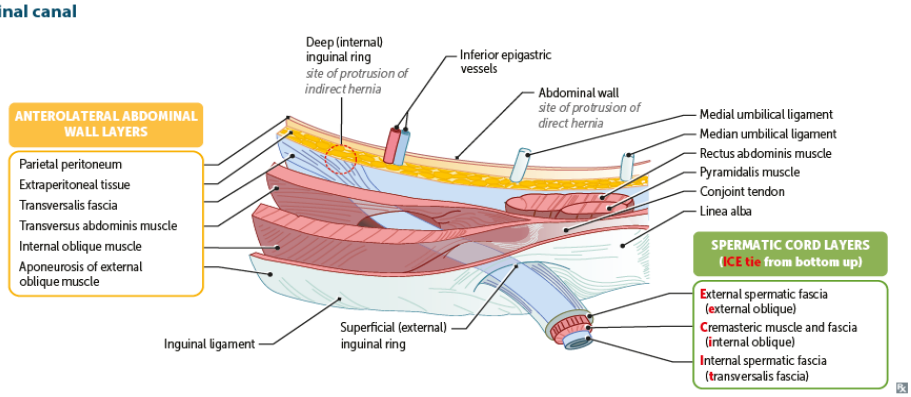
I also want you to know the transversalis fascia, which is a layer between the transverse abdominis muscle and the peritoneum:



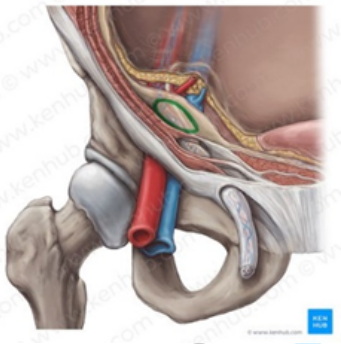
In the diagram below, we are looking at the abdomen from the inside. Notice the transversalis fascia in green, and I also want you to pay attention to the deep inguinal canal, which is **lateral** to the inferior epigastric vessels (Keep this very high-yield fact in mind for later, when we discuss hernias, specifically the **indirect hernia**).



*This might feel like too much info. But we need a strong base to build on!
*See the diagram below and study the contents of the yellow box for now.
(We are going to discuss each part in this pic as we go).

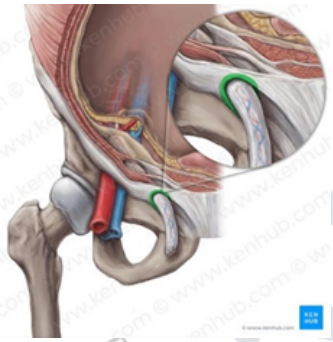


Deep Inguinal Ring



- It is an oval opening in the fascia transversalis
- Lies about ½ inch (1.3 cm) above the inguinal ligament, midway between the anterosuperior iliac spine and the symphysis pubis.
- Margins of the ring give attachment to the internal spermatic fascia (we are going to expand on that later).

Superficial Inguinal Ring



- Triangular-shaped defect in the aponeurosis of the external oblique muscle.
- Lies immediately above and medial to the pubic tubercle.
- Its margins, sometimes called crura (medial and lateral crus), give attachment to the external spermatic fascia.

Walls of The Inguinal Canal

➔ Anterior Wall of Inguinal Canal

- It is formed along its entire length by the aponeurosis of the external oblique muscle.
- It is reinforced in its lateral third by the origin of the internal oblique from the inguinal ligament.
- This wall is strongest where it lies opposite the weakest part of the posterior wall, that is deep inguinal ring.
(strongest part of the anterior wall = weakest part of the posterior wall = deep inguinal ring).

➔ Posterior Wall of Inguinal Canal

- It is formed along its entire length by the fascia transversalis (and not the transverse abdominis muscle!).
- It is reinforced in its medial third by the conjoint tendon, the common tendon of insertion of the internal oblique and transversus, attached to the pubic crest and pectineal line.
- This wall is strongest where it lies opposite the weakest part of the anterior wall, that is superficial inguinal ring.
(strongest part of the posterior wall = weakest part of the anterior wall = superficial inguinal ring).

➔ Inferior Wall of Inguinal Canal (Floor)

- It is formed by the rolled-under inferior edge of the aponeurosis of the external oblique muscle, called the inguinal ligament, and at its medial end, the lacunar ligament.

➔ Superior Wall of Inguinal Canal (Roof)

- It is formed by the arching lowest fibers of the internal oblique and transversus abdominis muscles

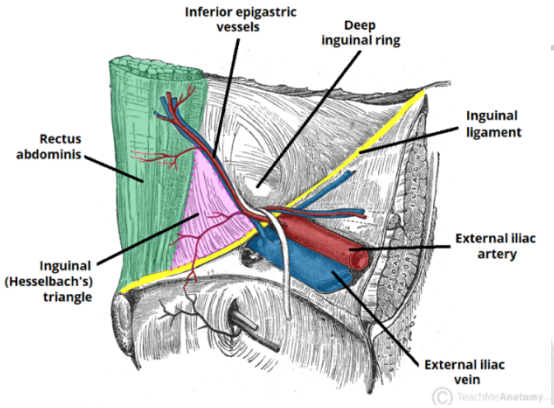
Function of the Inguinal Canal

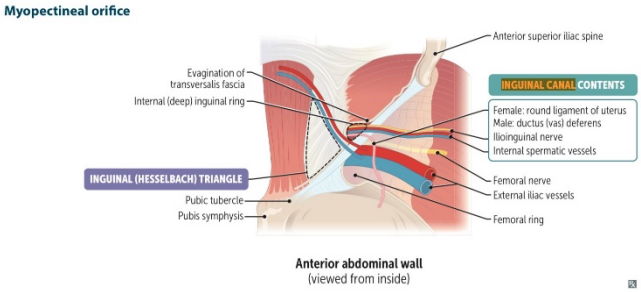
- Permits the passage of the round ligament of the uterus from the uterus to the labium majus in females.
- It allows structures of the spermatic cord to pass to and from the testis to the abdomen in males.

Inguinal (Hesselbach's) triangle

- Region of abdominal wall borders.

*To save you time and effort before studying the diagrams, orient yourself by knowing we are looking at the abdomen FROM THE INSIDE! Pretend you are sitting with the intestine :)





- Medial border: lateral margin of the rectus sheath, also called linea semilunaris
- Superolateral border: inferior epigastric vessels
- Inferior border: inguinal ligament

Contents of the Inguinal Canal

1. Either the spermatic cord and its contents in males

   OR

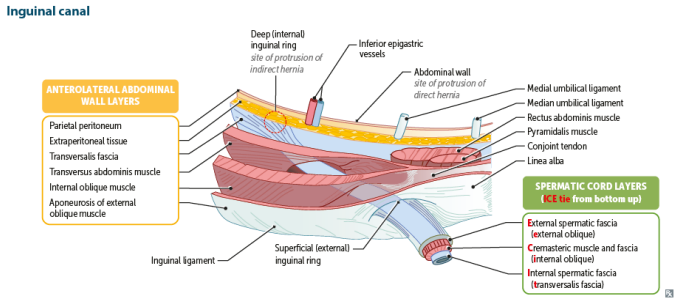
   Round ligament in females
2. **Ilioinguinal nerve**: Enter the canal through the posterior wall.

   *Notice how the ilioinguinal nerve is NOT part of the spermatic cord!

➔ Spermatic cord:

- It begins at the deep inguinal ring lateral to the inferior epigastric artery and ends at the testis, and it is covered with three concentric layers of fascia derived from the layers of the anterior abdominal wall.
- Each covering is acquired as the processus vaginalis descends into the scrotum through the layers of the abdominal wall.

*Remember this diagram from an earlier page? Take your time reviewing the green box this time.



External spermatic fascia: derived from the external oblique aponeurosis and attached to the margins of the superficial inguinal ring

Cremasteric fascia: derived from the internal oblique muscle

Internal spermatic fascia: derived from the fascia transversalis and attached to the margins of the deep inguinal ring.

Structures of the Spermatic Cord

1. Vas deferens
2. Testicular artery and vein
3. Testicular lymph vessels
4. Autonomic nerves
5. Processus vaginalis
6. Cremastric artery
7. Artery of the vas deferens
8. **Genital branch of genitofemoral nerve***

***Both the ilioinguinal nerve and the genital branch of the genitofemoral nerve are within the inguinal canal, **but only the genital branch lies within the spermatic cord; the ilioinguinal nerve runs WITH the spermatic cord within the canal!**

1. Vas deferens
- It is a cordlike structure
- Can be palpated between finger and thumb in the upper part of the scrotum
- It is a thick-walled muscular duct that transports spermatozoa from the epididymis to the prostatic urethra.

2. Testicular artery and veins
Testicular artery:
- It is a branch of the abdominal aorta at the level of L2
- Descends on the posterior abdominal wall
- It traverses the inguinal canal and supplies the testis and the epididymis

Testicular vein:
- These form the extensive venous plexus: the pampiniform plexus
- Leaves the posterior border of the testis
- As the plexus ascends, it becomes reduced in size so that at about the level of the deep inguinal ring, a single testicular vein is formed
- Drains into the left renal vein on the left side and the inferior vena cava on the right side

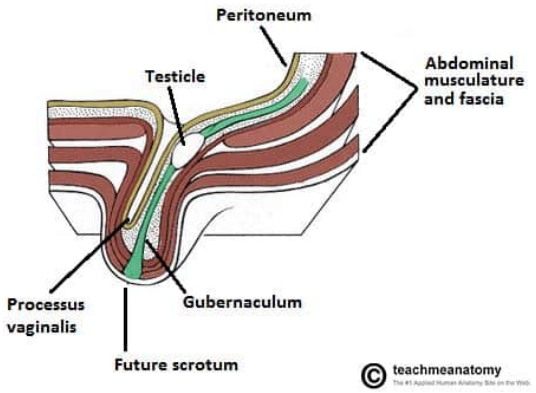
3. Testicular lymph vessels
- Ascend through the inguinal canal
- Passes up over the posterior abdominal wall
- Reach the lumbar (para-aortic) lymph nodes on each side of the aorta at level L1

4. Autonomic nerves
- Sympathetic fibers run with the testicular artery from the renal or aortic sympathetic plexuses
- Afferent sensory nerve

5. Processus vaginalis
- An out pouching of the peritoneum that in the fetus is responsible for the formation of the inguinal canal.
- Failure of obliteration (persistence) of the processus vaginalis leads to an indirect inguinal hernia.

8. Genital branch of the genitofemoral nerve
- Its root is formed by L1& L2
- Supply the cremasteric muscle

Some embryology for better understanding:



During development, the tissue that will become gonads (either testes or ovaries) establish in the posterior abdominal wall, and descend through the abdominal cavity. A fibrous cord of tissue called the **gubernaculum** attaches the inferior portion of the gonad to the future scrotum or labia, and guides them during their descent.

The inguinal canal is the pathway by which the **testes** (in an individual with an XY karyotype) leave the abdominal cavity and enter the scrotum. In the embryological stage, the canal is flanked by an out-pocketing of the peritoneum (processus vaginalis) and the abdominal musculature.

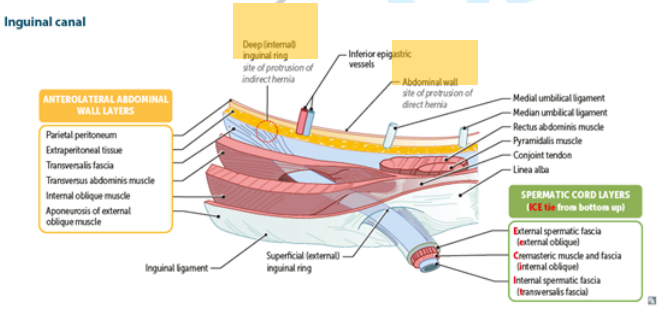
The processus vaginalis normally **degenerates**, but a failure to do so can cause an indirect inguinal hernia, a hydrocele, or interfere with the descent of the testes. The gubernaculum (once it has shortened in the process of the descent of the testes) becomes a small scrotal ligament, tethering the testes to the scrotum and limiting their movement.

Inguinal Hernia (Direct vs Indirect)

A hernia is the protrusion of part of the abdominal contents beyond the normal confines of the abdominal wall. And it consists of three parts:

1. The sac
2. Contents of the sac
3. Covering of the sac: Hernial coverings are formed from the layers of the abdominal wall through which the hernial sac passes.

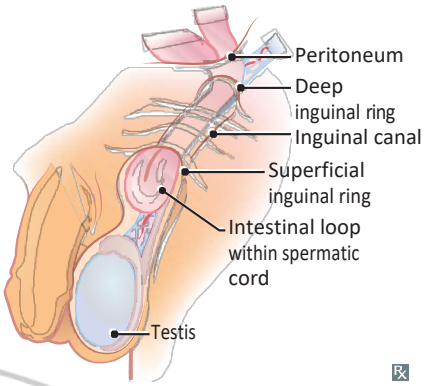
We have two types of hernia: indirect and direct.
*Notice exactly where each type occurs (highlighted in the pic below).



➔ Indirect hernia

- It is the **most common** form of hernia
- It is 20 times more common in young males than in females.
- It is more common on the right side (the rt. testis descends later than the lt. testis).
- It is believed to be congenital in origin.
- The hernial sac is formed by the remains of the processus vaginalis
- Enters the inguinal canal through the deep inguinal ring **lateral** to the inferior epigastric vessels, and it may extend part of the way along the canal or as far as the superficial inguinal ring.
- If the processus vaginalis has undergone no obliteration, the hernia is complete and extends through the superficial inguinal ring down into the scrotum or labium majus
- Under these circumstances, the neck of the hernial sac lies at the deep inguinal ring

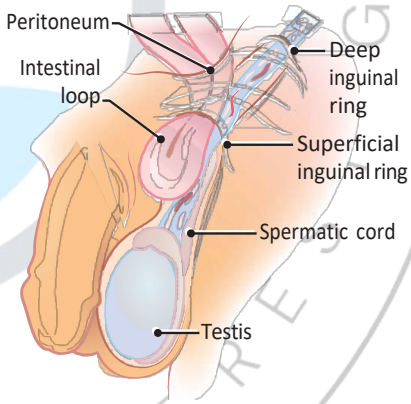
*The hernia's sac passes outside the boundaries of Hesselbach's triangle (inguinal triangle) and follows the course of the spermatic cord.



➔ Direct hernia

- It comprises about 15% of all inguinal hernias
- Common in old men with weak abdominal muscles and rare in women
- Hernial sac bulges forward through the posterior wall of the inguinal canal medial to the inferior epigastric artery
- The neck of the hernial sac is wide

*The hernia sac passes directly through the inguinal triangle and may disrupt the floor of the inguinal canal.



Comparison:

	Indirect	Direct
Age	young	Common on old
Bilaterally	unilateral	Usually bilateral
Shape	Oval	Hemispherical
Reaches scrotum	Can reach the scrotum	never
Direction of descent	Downwards, forwards medially	Forwards
Reduction	Upward, backward laterally	backward
Relation to inf. epigastric art.	Laterally	Medially
Superficial inguinal ring test	Feel an impulse on the tip of the finger	Feel the impulse on the side finger
Deep ring test: Reduction of hernia, put thumb over deep ring, ask patient to cough	Hernia does not appear	Hernia appears
Coverings	- Skin, superficial fascia, Ex.sp.fascia, cremasteric muscle & fascia, Int. spermatic fascia,	- Lat. To lat. Umbilical lig Same as indirection - Med. To lat.

[Scrotum]

- It is an outpouching of the lower part of the anterior abdominal wall.

Scrotum wall

- Its wall has the following layers:
  1. **Skin**: thin, wrinkled, and pigmented and forms a *single pouch*. A ridge in the midline indicates the line of fusion of the two lateral labioscrotal swellings.

  2. **Superficial fascia**:

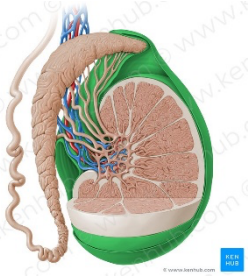
- Continuous with the fatty and membranous layers of the anterior abdominal wall
- The fat is replaced by smooth muscle called dartos muscle, which is responsible for the wrinkles of the skin.
- Membranous layer referred to as Colle's fascia
- Innervated by sympathetic nerve fibers
- Both layers of sup. fascia contribute to a median partition that crosses the scrotum and separates the testes from each other *(meaning, the skin is a single pouch and the testes are separated by the superficial fascia.)*

  3. Spermatic Fasciae

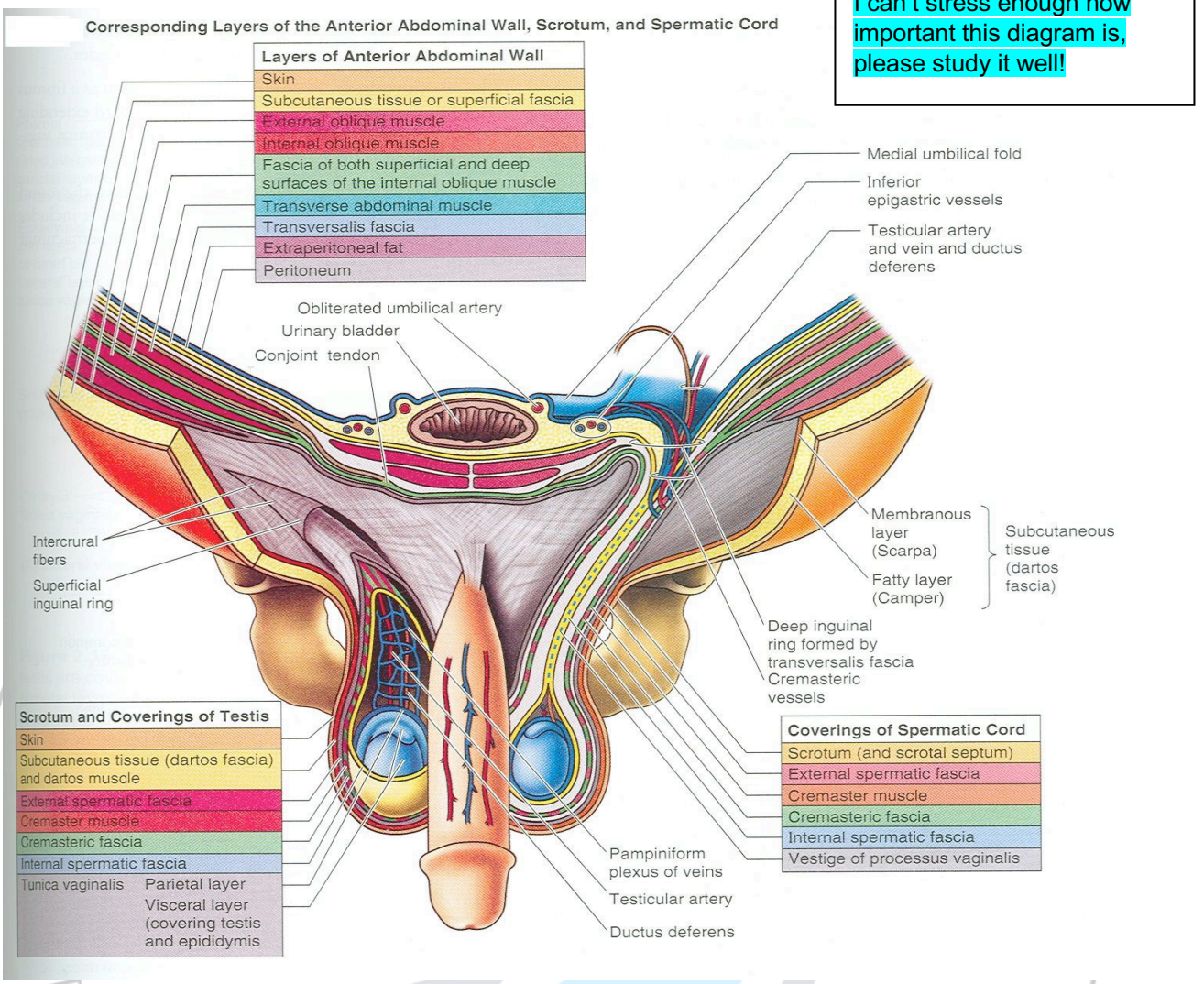
- Lies beneath the superficial fascia
- Derived from three layers of anterior abdominal wall on each side:
  →External spermatic fascia derived from external oblique
  →Cremastric fascia derived from internal oblique
  →Internal spermatic fascia derived from transversalis

  4. **Tunica vaginals** (parietal & visceral layer)

- Lies within the spermatic fasciae
- Covers the anterior, medial and lateral surfaces of each testis.
- It is the lower expanded part of the processus vaginalis.
- Normally shut off just before birth from the upper part of the processus and the peritoneal cavity.

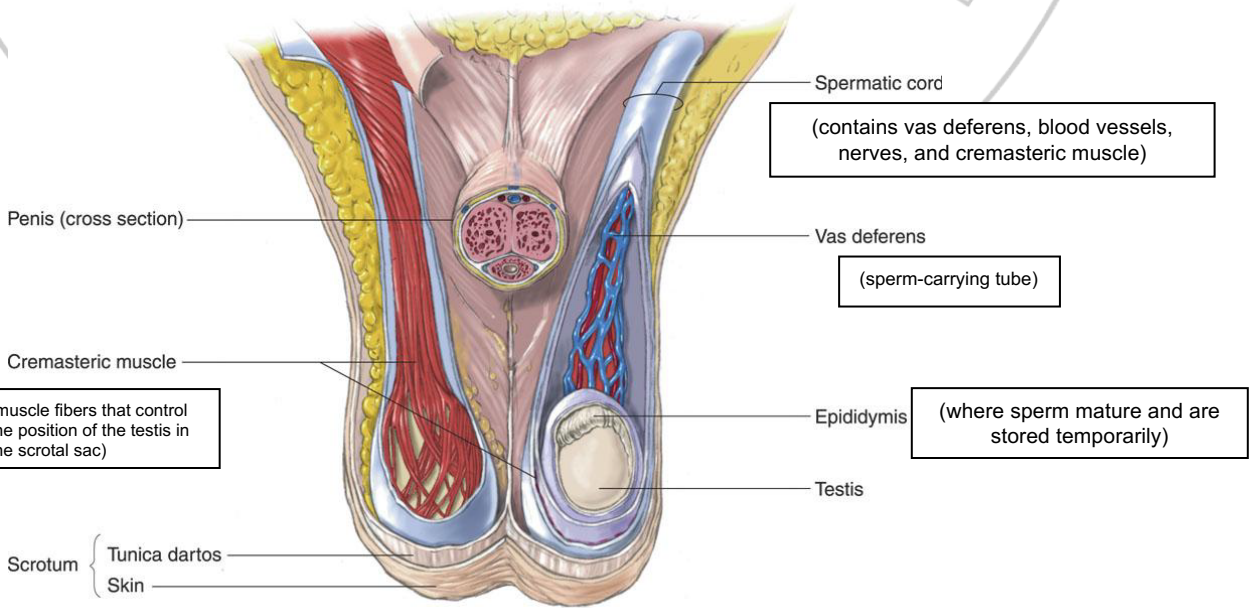


I can't stress enough how important this diagram is, please study it well!



Scrotum contents

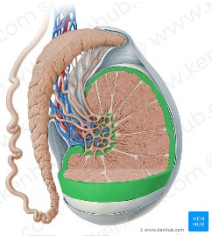
1. Testes,
2. Epididymis,
3. And the lower ends of the spermatic cord.



→Testis

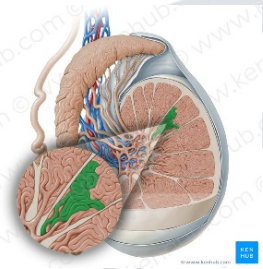
- They are a firm, mobile organs within the scrotum.
- The left testis usually lies at a lower level than the right.
- Upper end of the gland is tilted forward.

- Surrounded by a tough fibrous capsule, the tunica albuginea.



- A series of fibrous septa (first pic) divides the interior of the organ into lobules (2nd pic).

- Lying in each lobule are one to three coiled seminiferous tubules.



- The tubules open into the network of channels called the rete testis.

- Small efferent ductules connect the rete testis to the upper end of the epididymis.

→Structures inside the testis

Seminiferous tubules

Thin, highly coiled structures where sperm production occurs.

Interstitial cells

A major source of androgens
Located between the seminiferous tubules

Epididymis

Site of sperm maturation
Runs along the back of the testis

Vas deferens

Sperm-carrying tube
Begins at the testis and ends at the urethra.

→Blood supply of testes

Testicular arteries: arise from the abdominal aorta at the level L2

Pampiniform plexus: reduced to a single vein that ascends through the inguinal canal (shown below)

The right testicular vein drains into I.V.C.
&
The left testicular vein drains into the left renal vein.

This distinction will be important when we discuss the pathophysiology of varicoceles.

→Lymphatic drainage of testes (high yield)

- Ascend in the spermatic cord
- End in the lymph nodes on the side of the aorta *(**lumbar or para-aortic**)* nodes at level L1
- Scrotum and skin are drained by the *inguinal canal* lymphatic nodes

→Nerve supply to testes

Autonomic nerves

- Sympathetic fibers run with testicular artery from renal or aortic sympathetic plexuses
- Afferent sensory nerve

Genital branch of the genitofemoral nerve

- Supply the cremasteric muscle

Scrotum: By the nerves above + ilioinguinal nerve

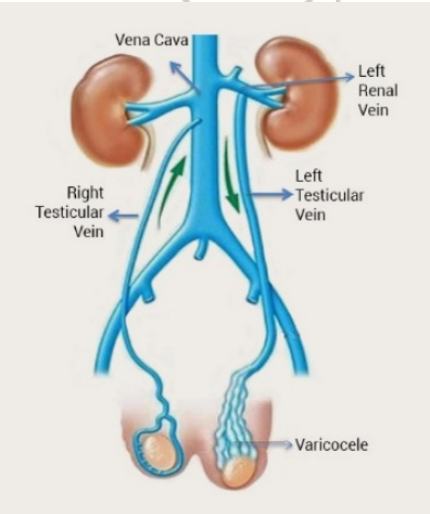
[Clinical conditions involving the scrotum and testes]

Varicocele

The veins of the pampiniform plexus become elongated and dilated.

It's more common on the left side due to several reasons; first, the left testicular vein drains into the left renal vein at a sharper angle. Second, there are fewer valves compared to the right testicular vein, and third, the left renal vein can get obstructed between the aorta and the superior mesenteric artery, leading to higher venous pressures in the left testicular vein.

Common in the young and in adults.

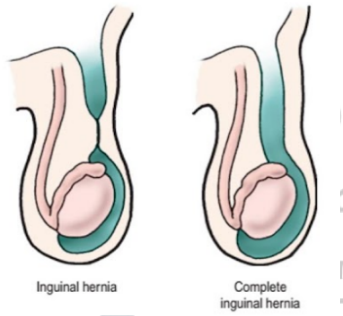


Processus vaginalis

Normally,
Upper part: obliterated just before birth.
Lower part: forms tunica vaginalis.

Congenital anomalies of the processus vaginalis

1. If it persists, it could lead to an indirect inguinal hernia.



2. If it is narrowed, it could lead to a congenital hydrocele

Hydrocele

Accumulation of fluid within the tunica vaginalis of the testis.

Causes

- Inflammatory
- Idiopathic

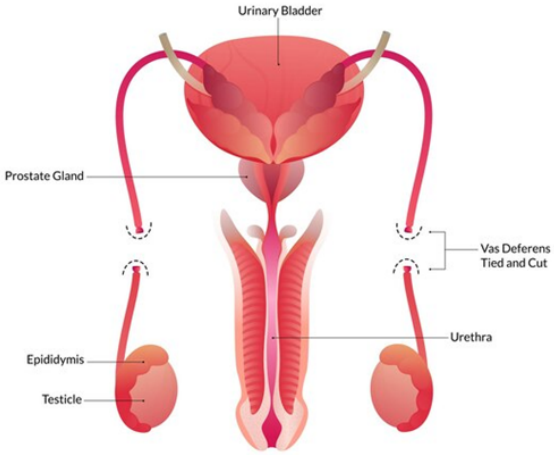
Rx: tapping, structures (all layers covering the testis, skin→tunica vaginalis) traversed by the cannula.

3. If it is obliterated from its upper and lower parts, it could lead to an encysted hydrocele of the cord.

Hydrocele of the cord (encysted hydrocele)

Vasectomy

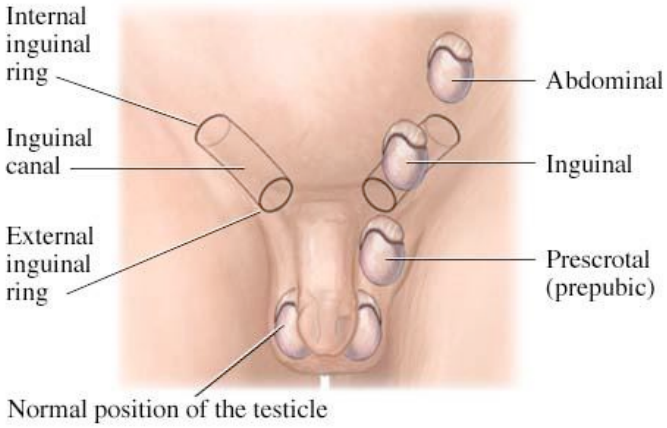
A **vasectomy** is a surgical procedure where we induce infertility, whether that is through tying, cutting, or having a section of the vas deferens removed.



Cryptorchidism

Incomplete descent of the testis, although traveling down the *normal pathway*

It may be found in:
1. Abdominal cavity
2. Inguinal canal
3. Superficial inguinal ring
4. Upper part of scrotum



Maldescent

Testes travel down an *abnormal pathway*

Will be found in/at:
1. Superficial fascia
2. Root of the penis
3. Perineum
4. Thigh

The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

The Peritoneum

Written by: Sereen Draghmeh

Edited by: Ghada T. Alzoubi

Reviewed by: Amr Abdallah

[Overview]

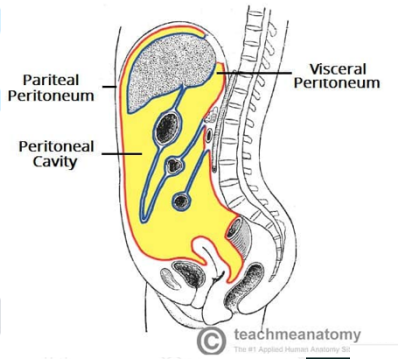
➔ **Outline of the Peritoneum we will cover:**

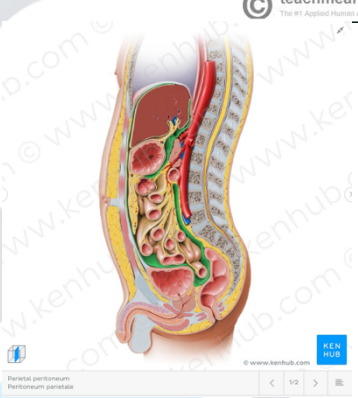
1) **General Features**
2) **Peritoneal Cavity**
    a. Lesser Sac
    b. Greater Sac
3) **Omental (Epiploic) Foramen**
    a. Position
    b. Boundaries of Omental Foramen
    c. Function of the Peritoneum
4) **Relationship Between Viscera and Peritoneum**
    a. Intraperitoneal Viscera
    b. Retroperitoneal Viscera
    c. Intraperitoneal Viscera
5) **Peritoneum Reflections and Ligaments**
    a. Omenta
    b. Mesenteries
    c. Ligaments of the Peritoneum
6) **Recesses, Fossae and Pouches**
    a. Duodenal Receses
    b. Cecal Recesses
    c. The Intersigmoid Recesses
    d. Pouches
7) **Compartments of the Peritoneal Cavity**
    a. Supracolic compartments
    b. Infracolic compartments

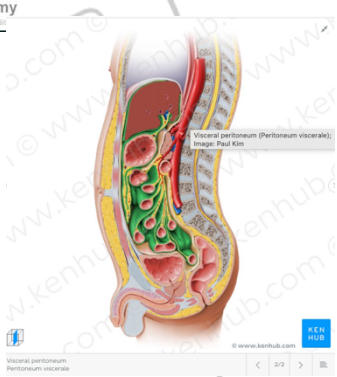
[General Features]

The peritoneum is a thin serous membrane
It consists of :

1. Parietal Peritoneum
    a. Lines the anterior abdominal wall
2. Visceral Peritoneum
    a. Covers the viscera
    b. Peritoneum is continuous below with the parietal peritoneum lining the pelvis
3. Peritoneal Cavity
    a. The potential space between the parietal and visceral layer of the peritoneum
    b. In male it's a closed sac
    c. In females, there is a communication with the exterior through the uterine tubes, the uterus, and the vagina

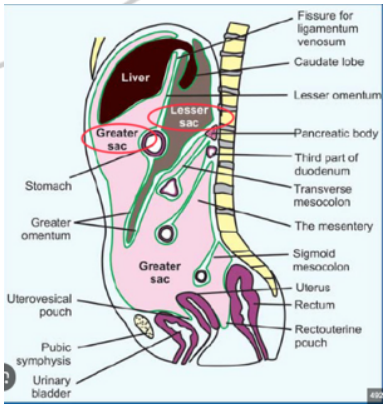






[The Peritoneal Cavity]

- It's divided into the :
    1. Greater Sac
    2. Lesser Sac
- Communication between them is through the epiploic foramen

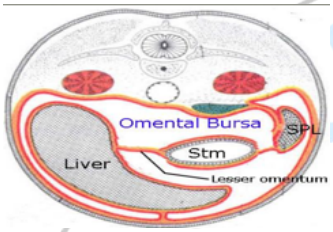


The Lesser Sac :

- The Lesser Sac is also called the Omental Bursa

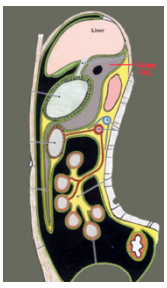
➔ **Location:**

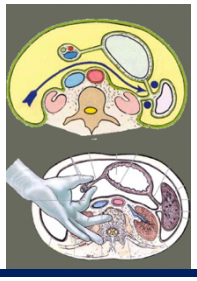
a) It's deep to the lesser omentum
b) It's behind the stomach
c) Between two layers of the greater omentum
d) Under the diaphragm and liver
e) Deep to lesser opening (epiploic opening)



➔ **Walls**:

1. Superior
   a. Peritoneum, which covers the caudate lobe of the liver and the diaphragm
2. Inferior
   a. Conjunctive area of the anterior and posterior two layers of the greater omentum
3. Left
   a. Spleen
   b. Gastrosplenic ligament
   c. Splenorenal ligament
4. Right
   a. Omental foramen
5. Anterior
   a. Lesser omentum, peritoneum of the posterior wall of the stomach, and the anterior two layers of greater omentum
6. Posterior
   a. Posterior two layers of the greater omentum, transverse colon, and transverse mesocolon peritoneum covering the posterior abdominal wall





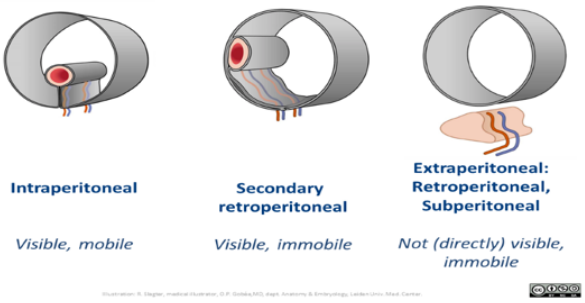
The Greater Sac:

➔ **Location:**

- Deep to the anterior abdominal wall
- Below the diaphragm
- Above the Pelvic Viscera

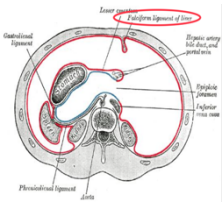
➔ **Organs and Peritoneal Relations in the Greater Sac :**

1) Liver :
   a. Almost entirely covered by visceral peritoneum, except for the bare area (direct contact with the diaphragm, no peritoneum in between)
2) Stomach
   a. Completely surrounded by peritoneum (intraperitoneal),
3) Transverse Colon
   a. intraperitoneal
4) Greater Omentum
   a. 2 layers of peritoneum from the greater curvature of the stomach
5) Duodenum
   a. The first and last inches are intraperitoneal, while the remainder of the duodenum is retroperitoneal
6) Small Intestine
   a. Entirely intraperitoneal (except duodenum), suspended by mesentery through which vessels/nerves reach it

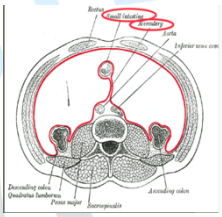


➔ **Subdivisions:**

1. Anterosuperior part
    a. Divided by the Falciform ligament into
        i. Right Part
        ii. Left Part



2. Posterior Inferior part
    a. Divided by the mesentery and small intestine into."
        i. Right Part
        ii. Left Part

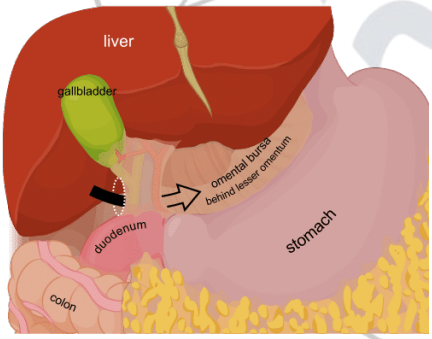


The Epiploic (Omental) Foramen

-Also called the foramen of Winslow
-The lesser sac (omental bursa) communicated with the greater sac through the omental foramen

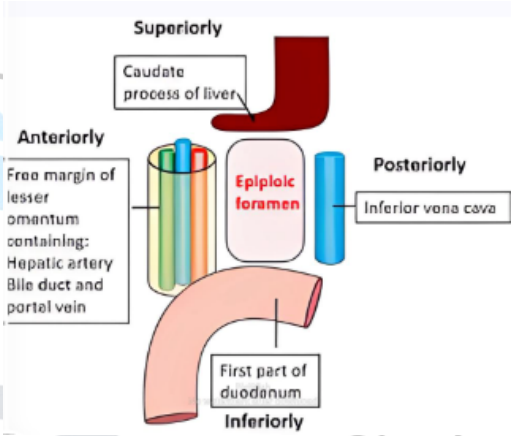
➔ **Location:**

- Lies between the liver and duodenum
- Just above the first part of the duodenum
- Behind the lesser omentum
- In front of the IVC
- Short, vertically flattened passage, about 3 cm



➔ **Boundaries:**

1. Anteriorly:
    a. Free border of the lesser omentum contains:
        i. Bile Duct (right and anterior)
        ii. Hepatic Artery (left and anterior)
        iii. Portal Vein (posteriorly)
2. Posteriorly:
    a. IVC
3. Superiorly:
    a. Caudate process of caudate lobe of liver
4. Inferiorly:
    a. First part of duodenum



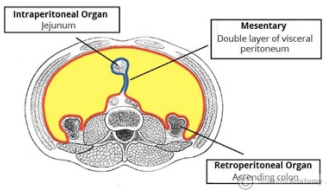
Function of the Peritoneum

1. Secretes a lubricating serous fluid that continuously moistens the associated organs
2. Fat storage
3. Defense role → the presence of lymphatic vessels and nodes
4. Supports Viscera

[The Relationship between the Viscera and Peritoneum]

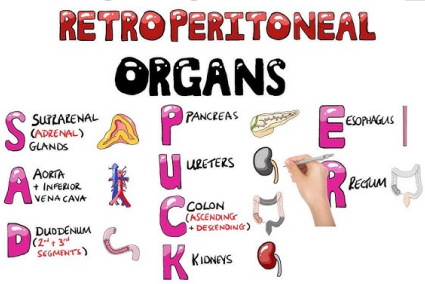
Intraperitoneal Viscera

- Viscera are almost totally covered with visceral peritoneum
- Examples
    - Stomach
    - 1st and Last Inch of Duodenum
    - Jejunum
    - Ileum
    - Cecum
    - Vermiform appendix
    - Transverse and Sigmoid Colons
    - Spleen
    - Ovary



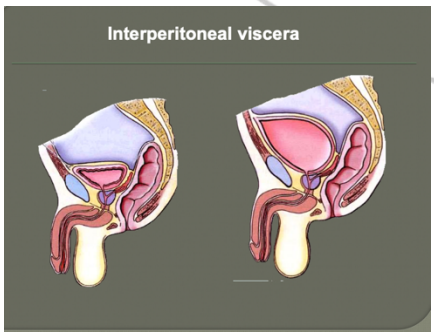
Retroperitoneal Viscera

- Some organs lie in the posterior abdominal wall
- Behind the peritoneum
- They are partially covered by the peritoneum on their anterior surface only
- Examples
    a. Suprarenal Gland
    b. Aorta + IVC
    c. Duodenum
    d. Pancreas
    e. Ureters
    f. Colons- Descending and Ascending
    g. Kidneys
    h. Rectum - Upper 3rd



Intraperitoneal Viscera

- Such organs are not completely wrapped by the peritoneum = Partially Intraperitoneal
- One surface attached to the abdominal walls or other organs
- Example:
    a. Liver
    b. Gallbladder
    c. Urinary Bladder
    d. Uterus



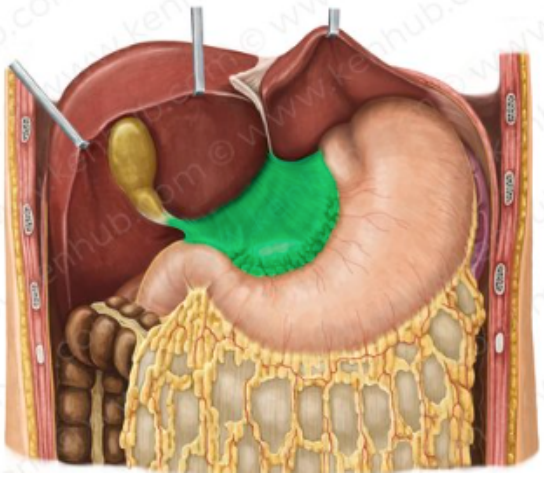
[The Peritoneal Reflections or Folds]

- Certain terms, often arbitrary, are commonly used for the peritoneal reflections.
- A peritoneal reflection that connects the intestine and body wall is usually named according to the part of the gut to which it is attached.
    a. The reflection to the jejunum and ileum is termed the mesentery
    b. That to the transverse colon is the transverse mesocolon.
- Some peritoneal reflections between organs or between the body wall and organs are termed ligaments or folds. Most of such ligaments or folds contain blood vessels.
- Broad peritoneal sheets associated with the stomach are termed omenta.

Omenta

- Omenta: 2-layered folds of peritoneum that extend from the stomach to adjacent organs
- 2 omentas :
    1. Lesser Omentum
    2. Greater Omentum

1. **Lesser Omentum**
    a. 2-layered fold of peritoneum
    b. Extends from the porta hepatis, fissure of ligamentum venosum, and the diaphragm to a lesser curvature of the stomach and the superior part of the duodenum



C.Ligaments

- **Hepatogastric Ligament:**

From the porta hepatis to the lesser curvature of the stomach

- **Hepatoduodenal Ligament:**

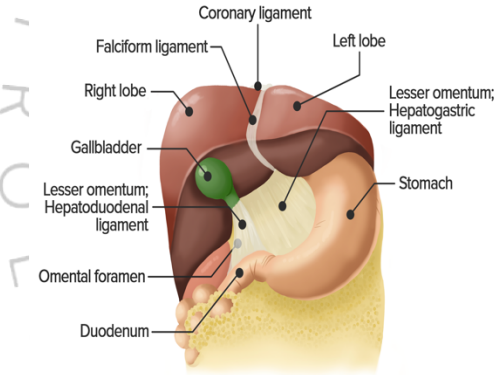
Extends from the porta hepatis to the superior part of the duodenum.

At its free margin, it encloses 3 structures:

1. Common Bile Duct: *Ant*
2. Proper Hepatic Artery: at the *Lt. of the Common Bile Duct*
3. Hepatic Portal Vein: *Post.*

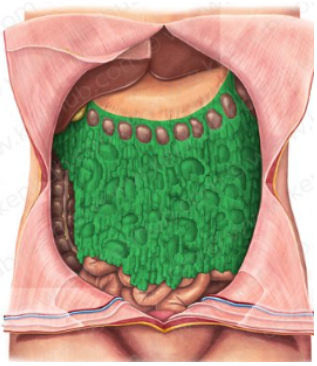
Contents:

- **Blood Vessels:** Right and Left Gastric Vessels
- **Lymph nodes & Lymphatic Vessels.**
- **Fat.**
- **Autonomic Nervous System:** Sympathetic + Parasympathetic (vagus nerve)



2. Greater Omentum

- It is the largest peritoneal fold.
- It consists of a double sheet, folded on itself so that it is made up of four layers.
- The anterior two layers descend from the greater curvature of the stomach and the superior part of the duodenum and hang down like an apron in front of coils of small intestine.
- Then turn up on the back of itself, and ascend to the transverse colon.
- The two layers are separated to cover the anterior and posterior surfaces of the transverse colon. Then they form the transverse mesocolon.
- The upper part of the greater omentum, which extends between the stomach and the transverse colon, is termed the gastrocolic ligament.
- In adults, the four layers of the greater omentum are frequently adhered together and are found wrapped about the organs in the upper part of the abdomen.
- Contents(between the descended layers):
  - **Gastroepiploic Vessels**
  - **Lymph nodes** and **Lymphatic Vessels**
  - **Fat**
  - **Autonomic Nervous System**
    - Sympathetic + Parasympathetic (vagus nerve)



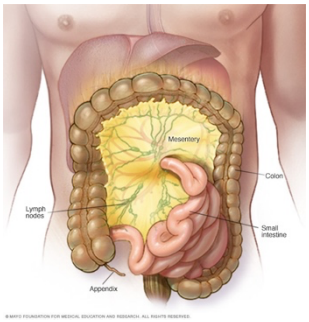
- Functions:
  - **Protective function**:
    - Contains numerous fixed macrophages.
  - **Storehouse for fat**:
    - Usually thin and presents a cribiform appearance
    - Always contains some adipose tissue, in fatty people its present in considerable quantity
  - **Migration and limitation**:
    - May limit the spread of infection; it migrates to the site of inflammation and wraps itself around such a site, referred to as the “policeman” of the peritoneal cavity.

Mesentry

- 2 Layered folds of peritoneum that attach the intestines to the posterior abdominal wall

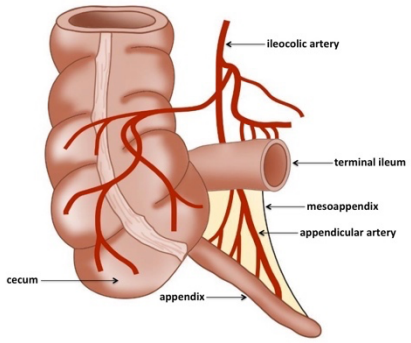
1. Mesentery of the Small Intestine

- Suspends the small intestine from the posterior abdominal wall.
- Broad and fan-shaped.
- Root of mesentery:
  - 15 cm long
  - Directed obliquely from the left side of the L2 vertebra to the right sacroiliac joint.
- Contents:
  - The jejunal and ileal branches of the superior mesenteric artery &veins
  - nerve plexuses
  - lymphatic vessels
  - the lymphatic nodes
  - connective tissue
  - fat



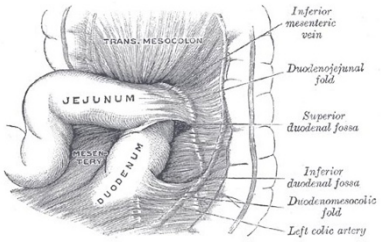
2. Mesoappendix

- Triangular mesentery – extends from the terminal part of the ileum to the appendix.
- Appendicular artery runs in the free margin of the mesoappendix.



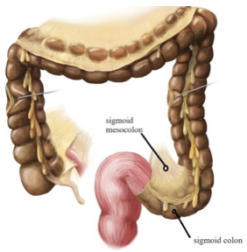
3. Transverse Mesocolon

- It's a broad fold
- Connects the transverse colon to the anterior border of the pancreas
- Contents:
  - Blood vessels
  - Nerves
  - Lymphatics of the transverse colon



4. Sigmoid Mesocolon

- It's a fold of peritoneum that attaches the sigmoid colon to the pelvic wall
- The left ureter descends into the pelvis behind its apex
- Contents:
  - Sigmoid vessels
  - Lymphatic vessels
  - Nerves



Ligaments

1. Ligaments of the Liver

- **The falciform ligament of the liver**
  - Consists of a double peritoneal layer
  - Sickle-shaped
  - Extends from the anterior abdominal wall (umbilicus) to the liver
  - Free border of the ligament contains Ligamentum teres (obliterated umbilical vein)
- **The ligamentum teres hepatis**
- **The coronary ligament:**
  - The area between the upper and lower layers of the coronary ligament

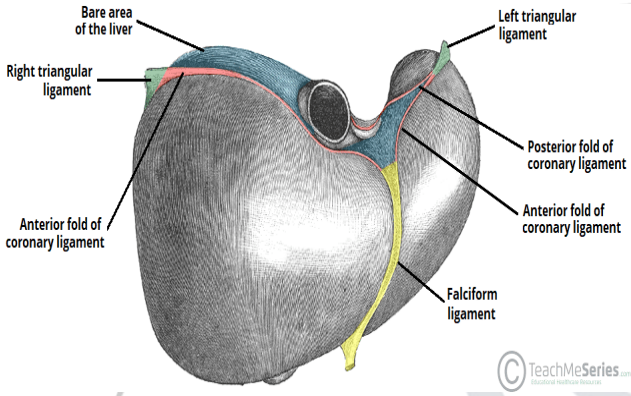
is the bare area of the liver, which contracts with the diaphragm.

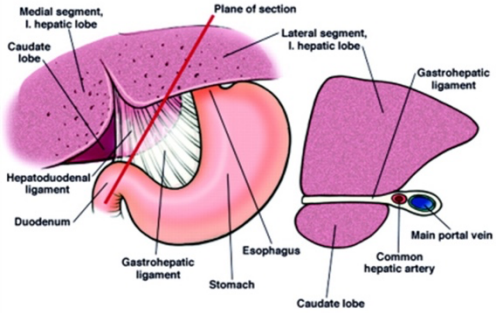
- **The left and right triangular ligament**

  Formed by the left and right extremities of the coronary ligament.

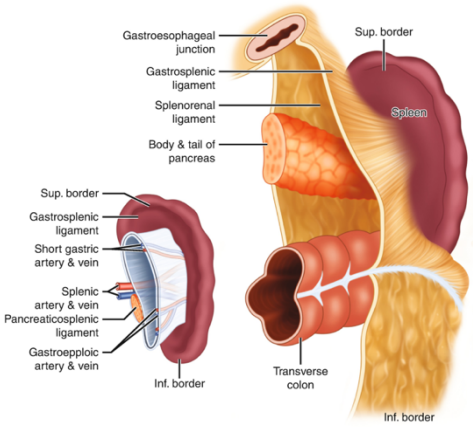
The hepatogastric ligament

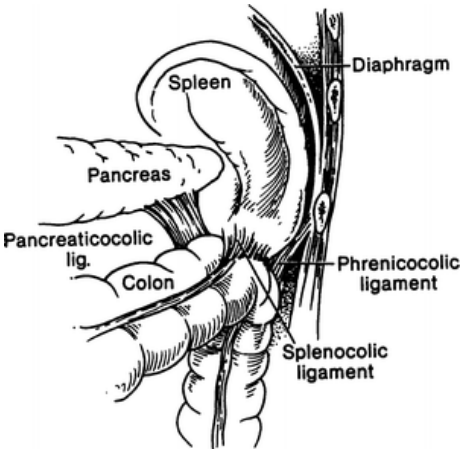
The hepatoduonedenal ligament



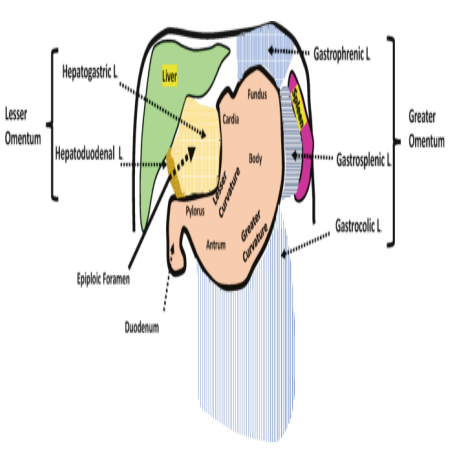


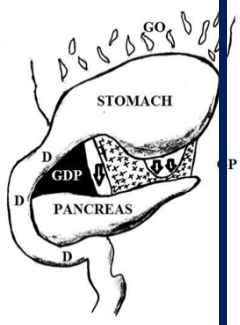
1. **Ligaments of Spleen**
   - Gastrosplenic ligament:
     - Connects the fundus of the stomach to the hilum of the spleen.
     - **Contents**:
       1. The short gastric & left gastroepiploic vessels pass through it.
   - Splenorenal ligament:
     - Extends between the hilum of the spleen and the left kidney.
     - **Contents**:
       1. The splenic vessel
       2. Lymphatic vessels, nodes & nerve
       3. the tail of the pancreas.
   - Phrenicosplenic ligament
   - Splenocolic ligament



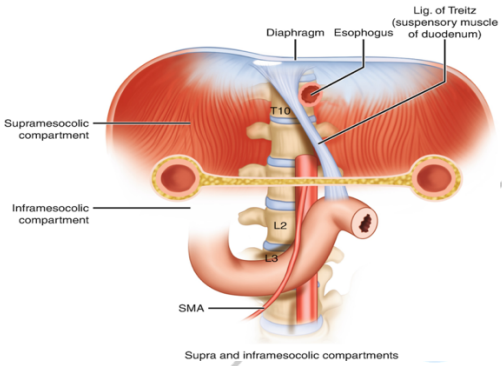


2. **Ligaments of the Stomach**
   - Hepatogastric ligament
   - Gastrosplenic ligament
   - Gastrophrenic ligament
   - Gastrocolic ligament
   - Gastropancreatic ligament



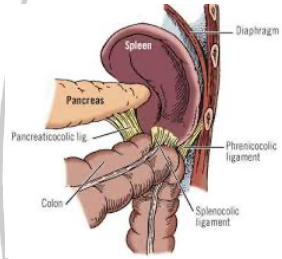


3. **The Suspensory ligament of the duodenum (Ligament of Trietz)**
    - Sometimes named the Trietz ligament at the junction between the duodenum and the jejunum



Supra and inframesocolic compartments

4. **The Phrenicocolic Ligament**
    - It is a fold of peritoneum which is continued from the left colic flexure to the diaphragm opposite the 10th and 12th ribs.



[Recesses, Fossae & Pouches]

- In certain parts of the abdomen, the peritoneal fold may bound recesses or fossae of the peritoneal cavity.
- At the junction between the intraperitoneal and retroperitoneal organs.
- These recesses are of surgical importance since they may become the site of internal herniae, that is, a piece of intestine may enter a recess and may be constricted (strangulated) by the peritoneal fold surrounding the entrance to the recess.
- From a surgical point of view, the omental bursa can be considered to belong to this category, with its opening at the epiploic foramen, bounded in front by the free border of the lesser omentum.
- They are sometimes found in relation to the duodenum, cecum, and sigmoid colon.

Recesses and Fossa's

1. **Duodenal Recesses**:
    - The superior duodenal recess or fossa
    - The inferior duodenal recess or fossa
    - The paraduodenal recess or fossa
    - The duodenojejunal recess or fossa
2. **Cecal recesses**:
    - The superior ileocecal or fossa
    - The inferior ileocecal or fossa
    - The retrocecal recesses or fossa
    - The rectocolic recess or fossa
3. **The intersigmoid recess**
    - Superior duodenal fold and recess
    - Inferior duodenal fold and recess
    - Intersigmoid recess – formed by the inverted V attachment of the sigmoid mesocolon
4. **Retrocecal recess**:
    - in which the appendix frequently lies
5. **Hepatorenal recess (Morison's Pouch)**:
    - lies between the right lobe of the liver, right kidney, and right colic flexure, and is the lowest part of the peritoneal cavity when the subject is supine.

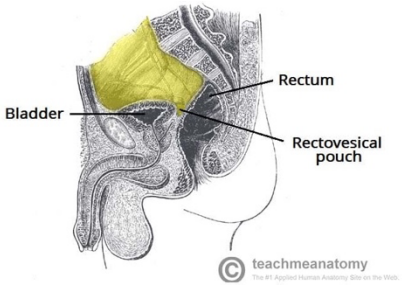
Pouches

- In the lesser pelvis, the peritoneum dips downwards, forming a larger fossa, named the pouch.

➔ **Clinical importance**
- internal abdominal hernia.

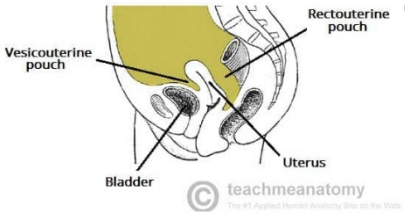
➔ **In males:**

1. **Rectovesical pouch**
   - lies between the rectum and urinary bladder (or the seminal vesicles and ampullae ductus deferentes).
   - The rectovesical pouch is the lowest part of the peritoneal cavity in anatomical position in males.



➔ **In females:**

1. **Rectouterine pouch (of Douglas)**
   - Between the rectum and uterus.
   - The rectouterine pouch is formed between the anterior surface of the rectum and the posterosurface of the uterus and the upper part of the vagina.
2. **Vesicouterine pouch**
   - Between the bladder and uterus.
   - The Vesicouterine pouch is formed between the anteroinferior surface of the uterus and the superior surface of the urinary bladder.



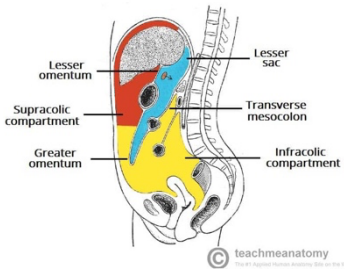
[Compartments of the Peritoneal Cavity]

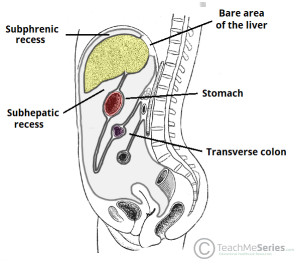
- The transverse colon and transverse mesocolon divide the greater sac into:
  - Supracolic compartments
  - Infracolic compartments.
  - Rt.extraperitoneal space (bare area of liver & diaphragm)

1. Supracolic compartments:

- **Subphrenic space:**

  Divided by the attachment of the falciform ligament into:
  - Rt.subphrenic space
  - Lt.subphrenic space
- **Subhepatic space is divided into:**
  - Rt.subhepatic space (Morison's pouch / Hepatorenal recess)
  - Lt.subhepatic space (lesser sac)





2. Infracolic compartment:

- Lies below the transverse colon and transverse mesocolon.
- Divided by the root of the mesentery of the small intestine into:
  - Rt. Infracolic compartment
  - Lt. infracolic compartment
- **Paracolic Gutters (Sulci):**

Right paracolic sulcus (gutter):

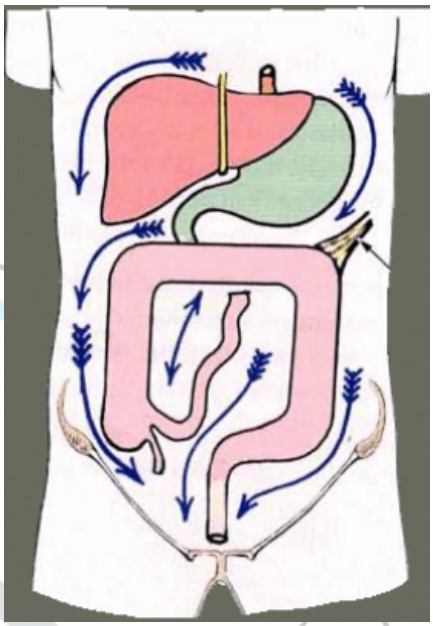
-Subdivide into:

- Rt.Lateral. paracolic
- Rt.medial.paracolic

-communicates with the hepatorenal recess and the pelvic cavity.

-It provides a route for the spread of infection between the pelvic and the upper abdominal region.

- **Left paracolic sulcus (gutter):** Subdivide into:
  - Lt.medial.paracolic
    - Lt.medial.paracolic open to the outside through the pelvis
  - Lt.Lateral paracolic
    - separated from the area around the spleen by the phrenicocolic ligament (a fold of peritoneum that passes from the colic flexure to the diaphragm).



The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

Esophagus & Stomach

Written by: Nabil Sweis & Reem Abuhamdah

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Reviewed by: Amr Abdallah

[Overview]

➔ **Outline of Esophagus and Stomach:**

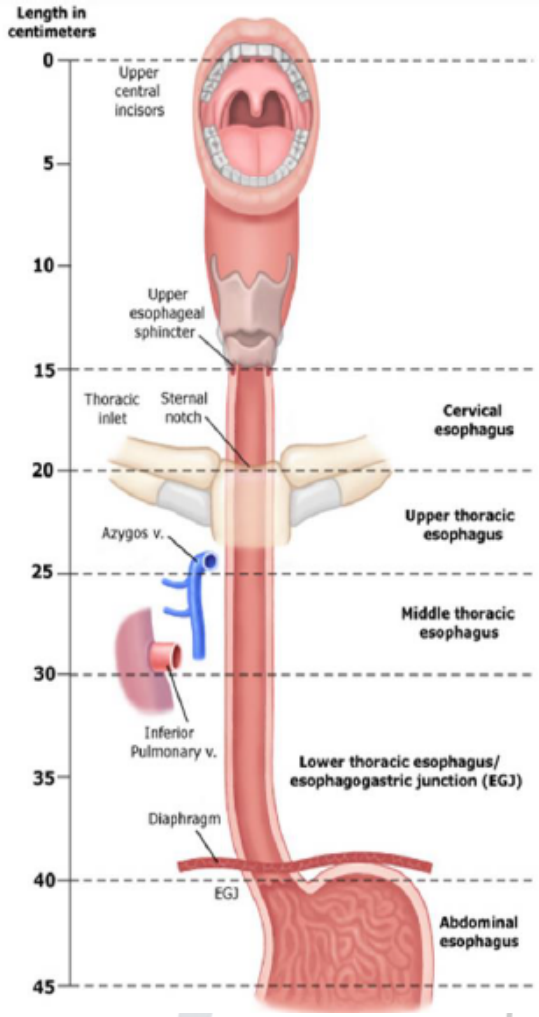
1. Esophagus
   - ➔ Anatomy of the esophagus
   - ➔ Blood supply of esophagus
   - ➔ Lymph drainage and nerve supply of esophagus

2. Stomach
   - ➔ Shape of the stomach
   - ➔ Function of the stomach
   - ➔ Parts of the stomach
   - ➔ Orifices and curvatures of the stomach
   - ➔ Glimpse into the Histology of the stomach
   - ➔ Peritoneum of the stomach
   - ➔ Relations of Stomach
   - ➔ Blood supply of the stomach
   - ➔ Venous drainage of the stomach
   - ➔ Lymphatic drainage of the stomach
   - ➔ Nerve supply of the stomach

3. Clinical notes

[Esophagus]

This is a concise step-by-step guide that will hopefully provide sufficient clarification and illustrations for the online lecture: The Esophagus. Each point mentioned in the slides will be explained separately. Please note that this guide seeks to illuminate and facilitate visualization, so extra details may be included for this purpose. For exam purposes, the slides should be adequate. Let's begin, shall we?



Slide 2: "The esophagus is a tubular structure (muscular, collapsible tube) about 10 in. (25 cm) long that is continuous above with the laryngeal part of the pharynx opposite the sixth cervical vertebra."

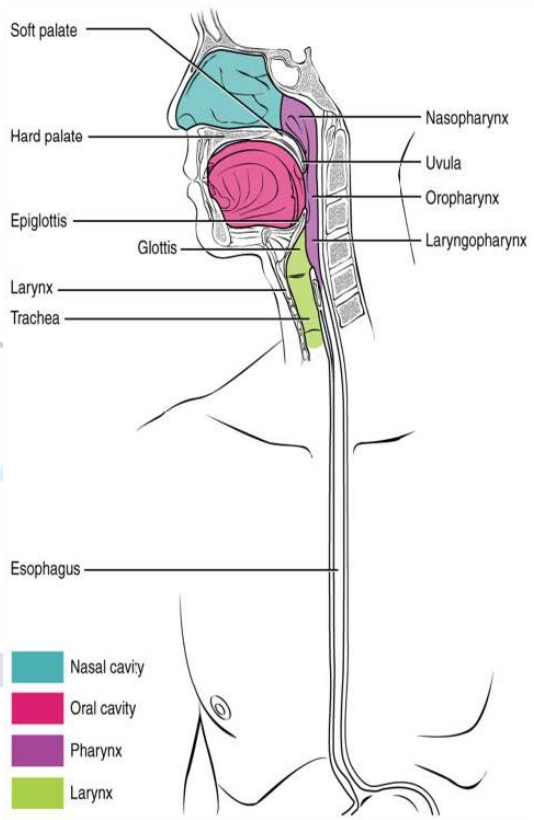
- The esophagus is basically a long "slide" for the bolus of food to have fun just before it reaches the harsh environment of the stomach. But unlike the typical slides you find in parks, this one is not plastic; it's made of muscle! Let's break down the sentence to further analyze it:
- "a tubular structure": the esophagus is simply a tube; cylindrical in shape with a hollow interior, to allow the passage of food.
- "muscular": the wall of the esophagus consists of many layers, some of which are muscular. This is important for the peristaltic movement that will propel food towards the stomach.

- "collapsible": To understand this feature, imagine the esophagus as if it's a tube of toothpaste. Look at the two adjacent images:
  *This author is not affiliated with Colgate.

- Notice that the image to the left shows a normal, brand-new toothpaste tube. To the right, notice the flatness of the squeezed toothpaste tube; it's collapsed! This is the definition of "collapsed". It refers to the fact that the space inside the esophagus can be abolished by bringing the walls close to each other. So, the esophagus is not a strictly firm structure, and its walls can move and change shape as part of its function.

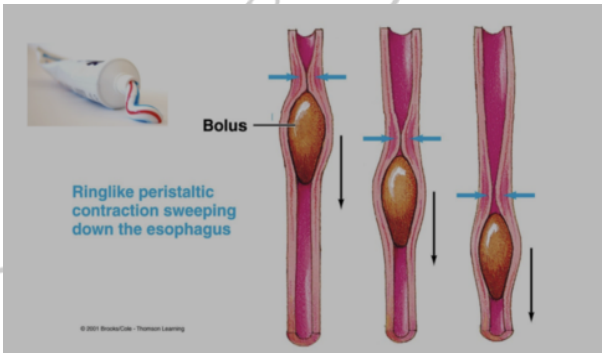
- "continuous above with the laryngeal part of the pharynx opposite the sixth cervical vertebra": the esophagus does not immediately begin after the oral cavity. Recall that the swallowed bolus of food first enters an intermediate chamber (the pharynx), which is highlighted in purple in the following image. This chamber acts like an airport. The passengers (food or air) are sorted in this chamber so that each passenger can take the right flight and reach the correct destination. If food enters this chamber, it should proceed into the esophagus. If air enters, it should usually proceed into the larynx and respiratory tract. In our context, we will focus on the esophagus, which is the path that food will have to go through to be digested later on. The pharynx is divided into the nasal, oral, and laryngeal parts. The lowest part (laryngeal) is the one that directly communicates with the esophagus. The esophagus starts approximately at the level of C6.

Slide 2: "The esophagus conducts food from the pharynx into the stomach.



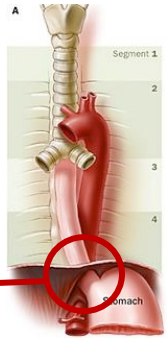
"Wavelike contractions of the muscular coat, called peristalsis, propel the food onward."

As we've established, the esophagus is a passageway for food. The movement of food within the esophagus is assisted by peristalsis, in which contraction takes place above the bolus of food, and relaxation below, to allow the food bolus to move towards the stomach. The adjacent image may help visualize this movement.



Slide 2: "It passes through the diaphragm at the level of the 10th thoracic vertebra to join the stomach."

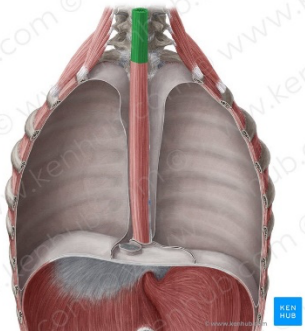
- This is best clarified through an image. As the esophagus descends downwards, it pierces the diaphragm just before reaching the stomach. The esophagus pierces the diaphragm at the level of T10.

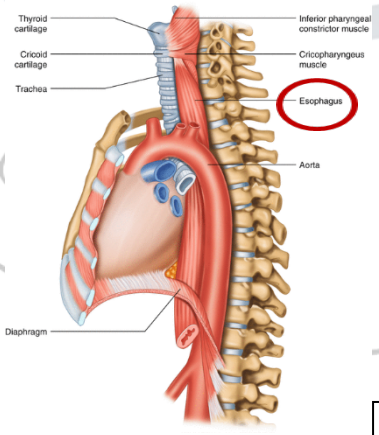


***Remember the mnemonic**
"I ate 10 eggs at 12 AM."
which refers to each of the IVC, esophagus, and aorta piercing the diaphragm at different levels as:
IVC (I) → T8 (ate)
Esophagus (eggs) → T10
Aorta (AM) → T12

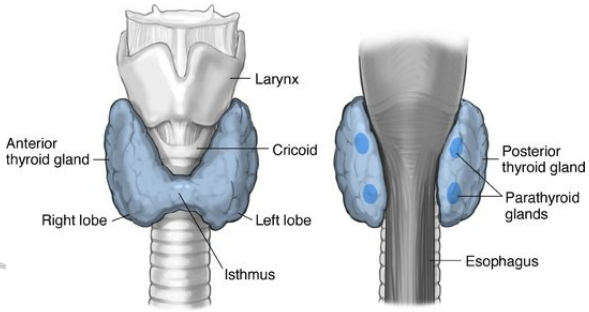
Slide 2: "In the neck, the esophagus lies in front of the vertebral column; laterally, it is related to the lobes of the thyroid gland, and anteriorly, it is in contact with the trachea and the recurrent laryngeal nerves."

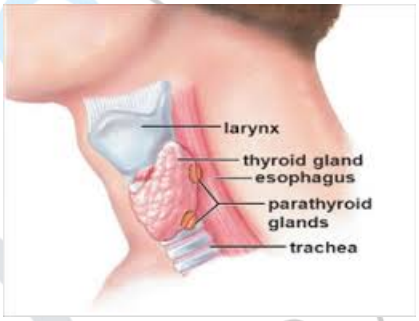
- We will first discuss the relations of the cervical part of the esophagus (i.e., in the neck).
- This part needs a lot of imagination. We will need even more images to help us on this one!
- "In the neck, the esophagus lies in front of the vertebral column": Look at the location of the vertebral column relative to the esophagus in the neck: The esophagus is in front!



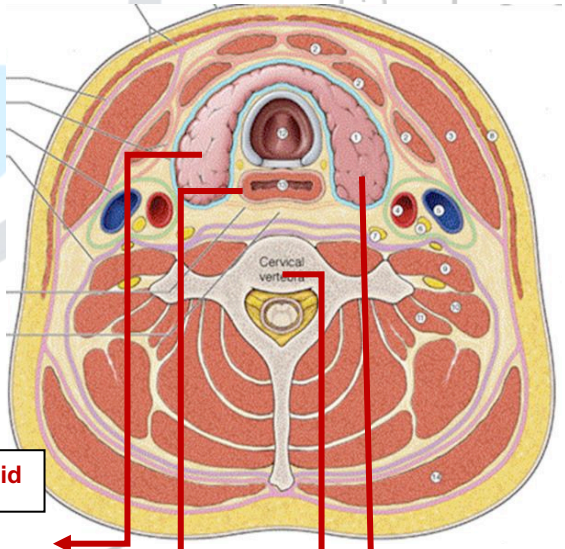


- "Laterally, it is related to the lobes of the thyroid gland": Look at the two images below. You can see how the thyroid gland lies anterior to the trachea, but the lobes extend posteriorly to the sides of the esophagus.



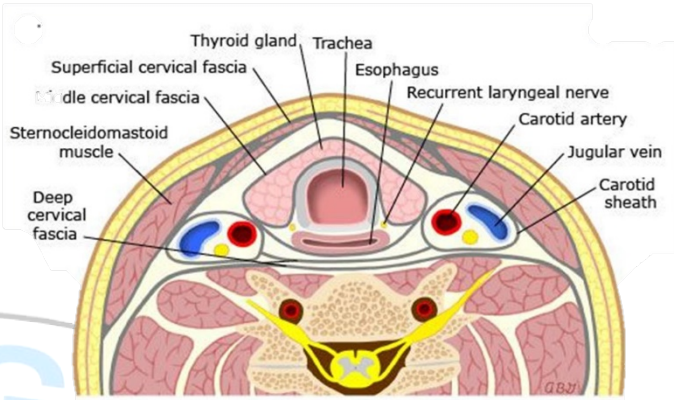


- Here is a superior view to further help you imagine the relations.



- "…and anteriorly, it is in contact with the trachea and the recurrent laryngeal nerves":

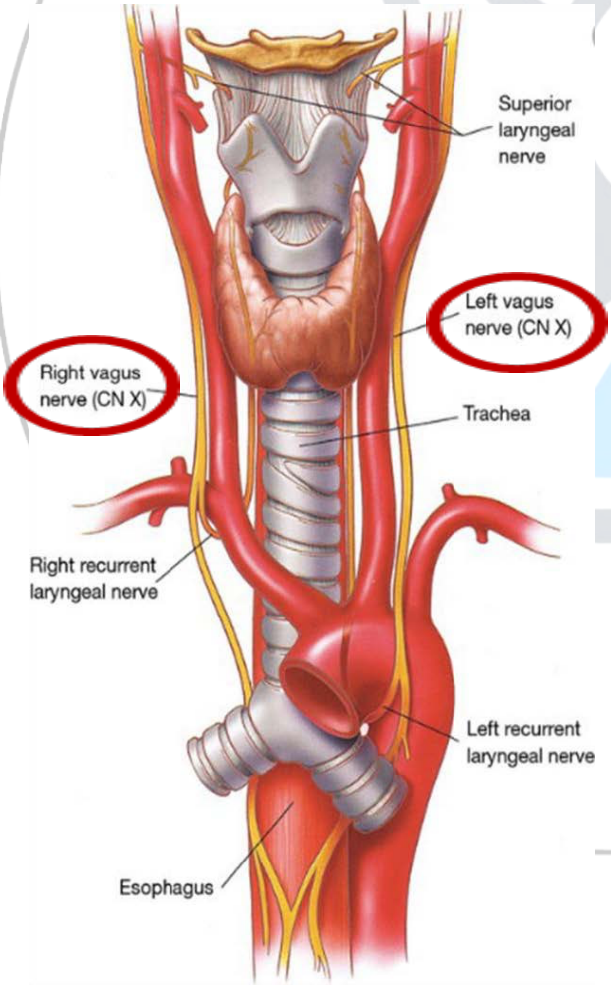
- The trachea, as you might have noticed from the previous images, is anterior in position relative to the esophagus.
- Before we look at the recurrent laryngeal nerve, let's briefly talk about its origin:
- It is a branch from the vagus nerve. Recall that the vagus nerve exits the cranial cavity through the jugular foramen and descends in the neck. At some point in its path, it gives a branch called "the recurrent laryngeal nerve".
- It is called "recurrent" because the nerve follows a path in reverse direction. Notice that it is ascending, in contrast to its parent nerve (the vagus nerve) which was descending. The recurrent laryngeal nerve ascends towards the larynx to supply muscles there, and during its path, it can be found anterior to the esophagus. The following image can further clarify its position. Note that we have left and right vagus nerves, and consequently, left and right recurrent laryngeal nerves.

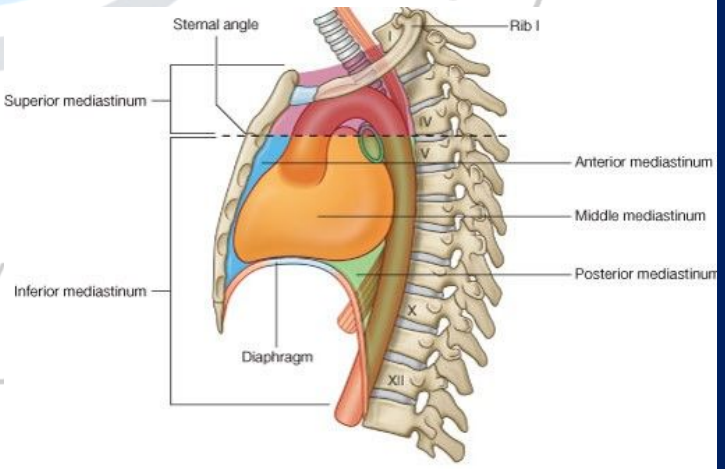


Slide 2: "In the thorax, it passes downward and to the left through the superior and the then the posterior mediastinum.

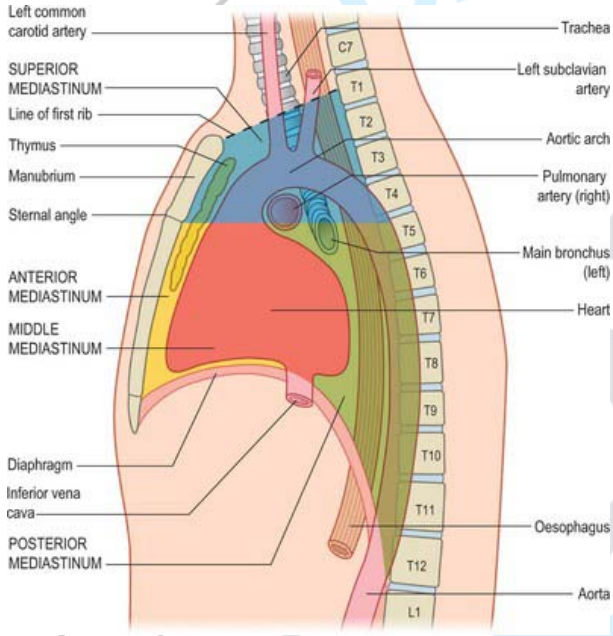
- We finished the part of the esophagus located within the neck. Now, we will be looking at the esophagus within the thorax.
- Firstly, let's refresh our memory and define the mediastinum.
- The mediastinum in its simplest definition is a cavity/space located between both lungs. One of the most important structures you can find here is the heart!
- Borders of the mediastinum: superiorly: the thoracic inlet, inferiorly: the diaphragm, laterally: mediastinal pleura (or lungs for simplicity), anteriorly: sternum and costal cartilages, posteriorly: thoracic part of vertebral column.

*In the following image, try to identify the structures we just discussed and describe their location relative to the esophagus (vertebral column, thyroid gland, recurrent laryngeal nerves, trachea).



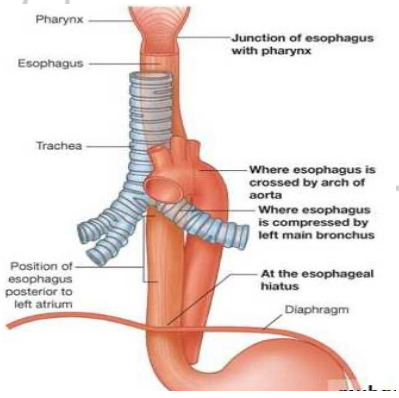


- The mediastinum is subdivided into superior and inferior parts, and the inferior part is further subdivided into anterior, middle and posterior parts (the terms are color-coded to match the following image).
- OK, where were we? Oh, the esophagus within the thoracic cavity. Now that you know the different parts of the mediastinum, refer to the following image and notice how the esophagus first enters the superior mediastinum, and then enters the inferior mediastinum, or more specifically, the posterior mediastinum.



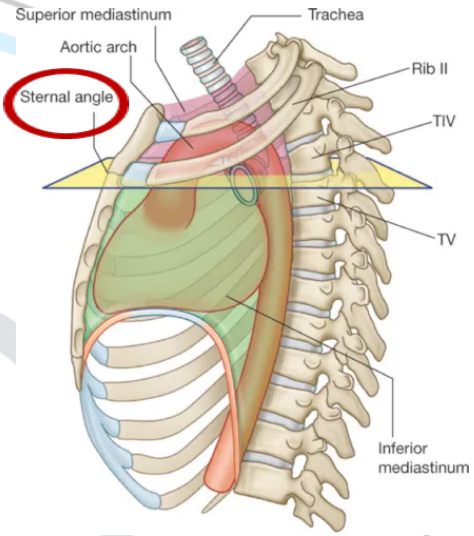
- Another important note is that the esophagus does not follow a completely vertical path. It slightly curves to the left as it descends (the esophagus soon returns to the midline, as will be demonstrated in the next section).

*Most diagrams do not depict the curvature very clearly. Perhaps, it is not even prominent anatomically. The best image I found is the one you can see to the right.



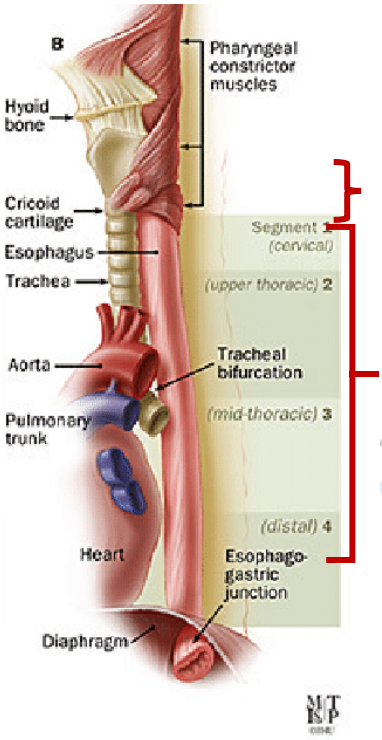
Slide 2: "At the level of the sternal angle, the aortic arch pushes the esophagus over to the midline"

- Refer to the image in which we demonstrated the curvature of the esophagus to the left. Notice how the esophagus returns to its midline position, and this is because the aortic arch pushes the esophagus back to the midline at the level of the sternal angle.
  *The following image shows the sternal angle for those who are wondering what it is.



Slide3: "The relations of the thoracic part of the esophagus:
Anteriorly: the trachea and the left recurrent laryngeal nerve; the left principal bronchus, which constricts it; and the pericardium, which separates the esophagus from the left atrium."

- The esophagus, as it descends in the thoracic cavity, is related to many structures.
- Anterior to the thoracic esophagus, you can find the trachea and recurrent laryngeal nerves. These structures were also anterior to the esophagus in the neck! They lie partially in the thoracic cavity and partially in the neck, which explains why they can be seen anterior to both the cervical and thoracic esophagus.

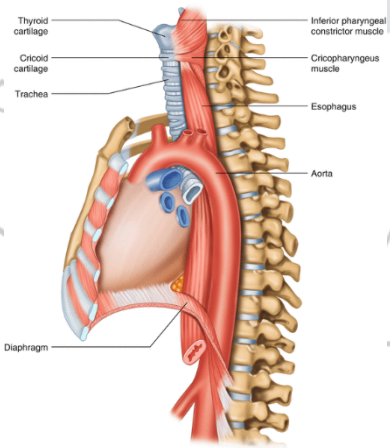


-Notice this is the part of the esophagus which lies in the neck. You can see the trachea in front of it.

-As for the thoracic part, you can see the trachea anterior to the upper part of the thoracic esophagus. (This is a lateral view). Recurrent laryngeal nerves are not shown here.

- The trachea bifurcates **at the level of T4**, giving rise to two principal bronchi (right and left). Recall when we said the esophagus curves to the left one page ago. Due to this curvature to the left (and perhaps other anatomical reasons), the esophagus is now related to the left principal bronchus.
- If you look closely at the previous image, you can notice how the left bronchus slightly presses against the esophagus. Thus, the left bronchus slightly constricts the esophagus here.

- The esophagus also passes behind the heart as it descends (look at the image beside), more specifically behind the left atrium.

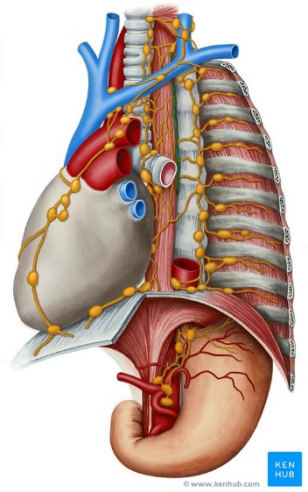


- Recall that the heart is surrounded by a fibrous coat: the pericardium! This fibrous layer separates the esophagus from the left atrium.

Slide 3: "Posteriorly: the bodies of the thoracic vertebrae; the thoracic duct; the azygos veins; the right posterior intercostal arteries; and, at its lower end, the descending thoracic aorta."

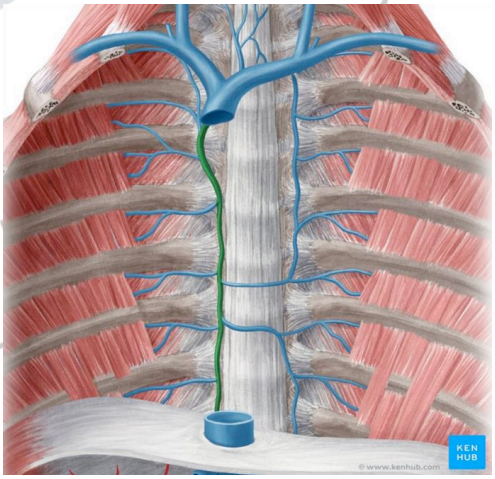
- The esophagus is certainly a *social* organ; it has plenty of relations! Let me introduce you to the posterior friends of the thoracic esophagus:
- The bodies of the thoracic vertebrae: this one is pretty straightforward. You can refer to many of the previous images and see this relation. The vertebral column is a friend of many structures; that's no surprise!

- Thoracic duct: This structure is responsible for collecting lymph, if you remember. It ascends upwards to finally drain into the venous angle of the left subclavian and internal jugular veins (highlighted in green).



- Azygos ceins: Name sounds scary? No worries, you'll be good friends with this vein by the time we're over. Let's get to know him (or her, as you like) a bit to break the ice.

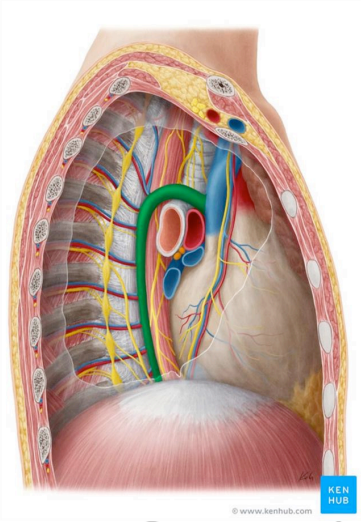
  *It is the vein highlighted in green. More images are on the way (see next page)!



- What's one of the first questions you ask a new friend?

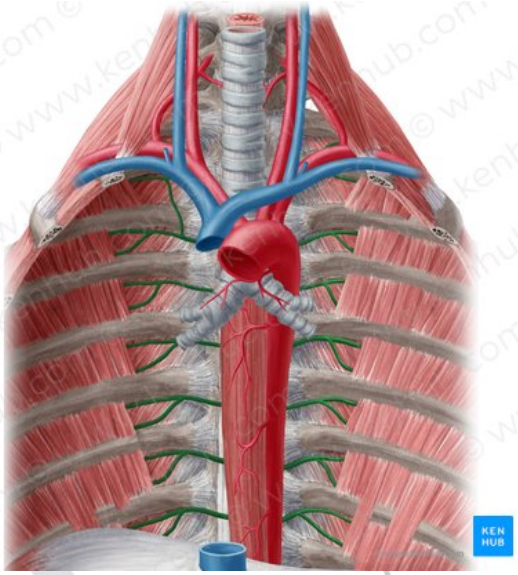
Where are you from? The azygous vein is variable in its origin. Let's stick with the simplest variation: it originates from the posterior aspect of the inferior vena cava, ascends vertically upward in front of the vertebral column, and finally drains into the superior vena cava. So, it originates in the abdomen, but then enters the posterior mediastinum.

- As it ascends in the thoracic cavity, it receives tributaries from the RIGHT posterior intercostal veins. Overall, it drains the upper lumbar region and the thoracic wall.
  *Notice: **we have ONE azygos vein**, and it is **located to the right** (it is a unilateral vessel). The sentence in the slides says "azygos VEINS", I could not explain why, but perhaps it is intended to say the azygos system of veins instead (because this system includes the azygos vein, hemiazygos vein, etc.).
  Ok, you should be familiar with our friend by now. Now, in order to see how it relates to the esophagus, look at the following image, and see how it lies posterior to the esophagus (azygos vein is highlighted in green).

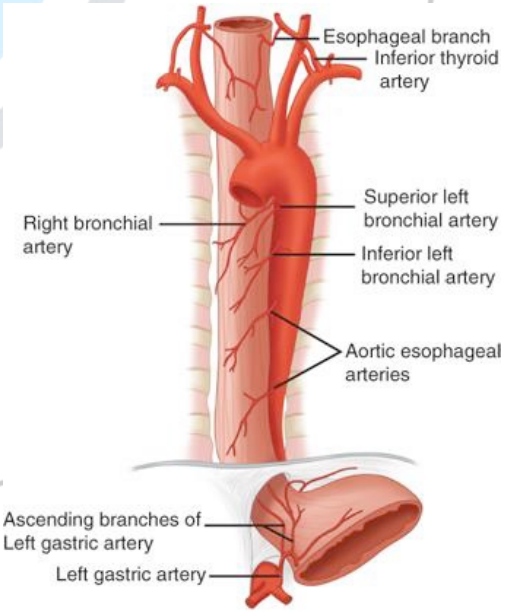


- Right Posterior Intercostal Arteries: these arteries originate from the thoracic aorta (with some exceptions). Look at the following image, notice how the RIGHT posterior intercostal arteries originate from the thoracic aorta, pass posterior to the esophagus, and then continue their path along the ribs. By now, you should have figured out why we said RIGHT only. The thoracic aorta (in the image shown) is still located to the left of the esophagus, so when the left posterior intercostal arteries emerge, they don't pass behind the esophagus, because the esophagus is on the other side (right)!

- Descending thoracic aorta: wait, didn't we just say that the thoracic aorta lies to the left of the



esophagus? Then why is it among the posterior relations?
  Well, the thoracic aorta is initially located to the left, but as it descends – and just above the diaphragm – it becomes posterior to the esophagus. This is why it is included in the posterior relations. The following image should make everything clear (look at how the aorta curves backward).

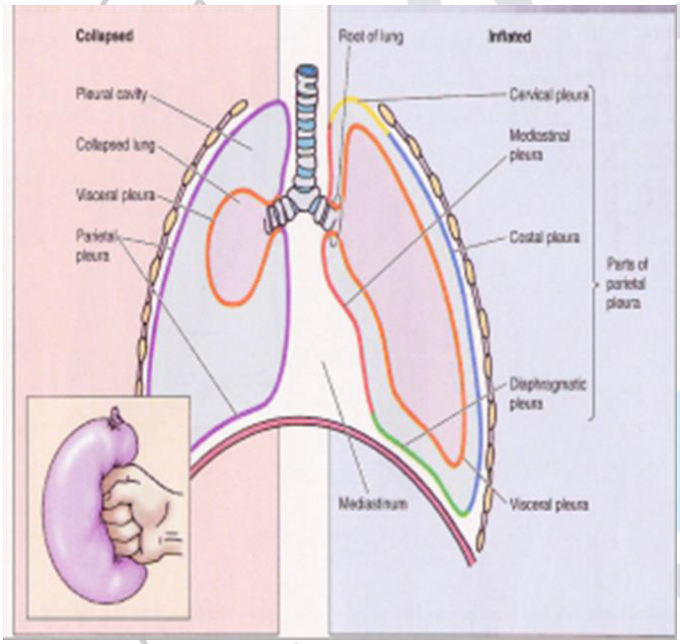


Slide 3: "Right side: the mediastinal pleura and the terminal part of the azygos vein."

- To the right of the esophagus, you will find the terminal part of the azygos vein. Recall the

azygos vein -as it ascends- lies posterior to the esophagus. The terminal part, however, curves to the right to drain into the SVC. So, the terminal part can be found to the right of the esophagus. Refer to the image of the azygos vein to get a clearer picture.

- Mediastinal Pleura: We know that the pleura is a serous membrane that lines the thoracic cavity (parietal pleura) and covers the lung (visceral pleura). The parietal pleura was divided according to the surface it faces: mediastinal pleura (faces the mediastinum), diaphragmatic pleura (faces the diaphragm) …etc.
- We're currently interested in the mediastinal pleura. Since the esophagus passes through the mediastinum, we expect the mediastinal pleura to be related to both sides of the esophagus.

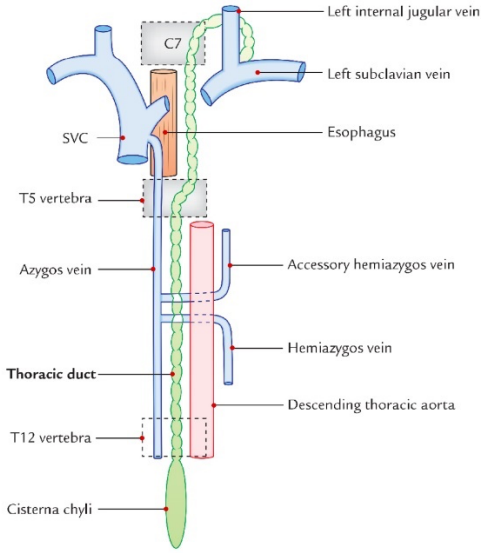


Slide 3: "Left side: the left subclavian artery, the aortic arch, the thoracic duct, and the mediastinal pleura."

- To the left of the esophagus, we find:

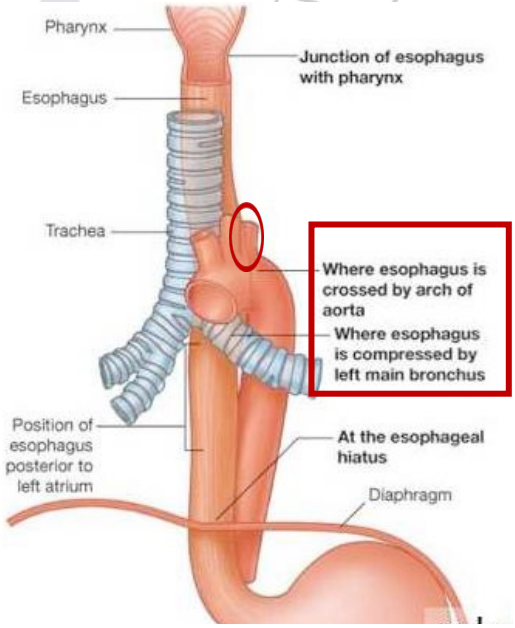
left subclavian artery: it emerges from the arch of the aorta (it is circled below). It can be found during its path on the left side of the esophagus.
*Please read the notes in the red box in the image below (they reaffirm what we discussed previously)

The thoracic duct: if you refer to the image of the thoracic duct (which we discussed earlier), you will notice that after it passes posterior to the esophagus, it then curves to be located on the left side of the esophagus.



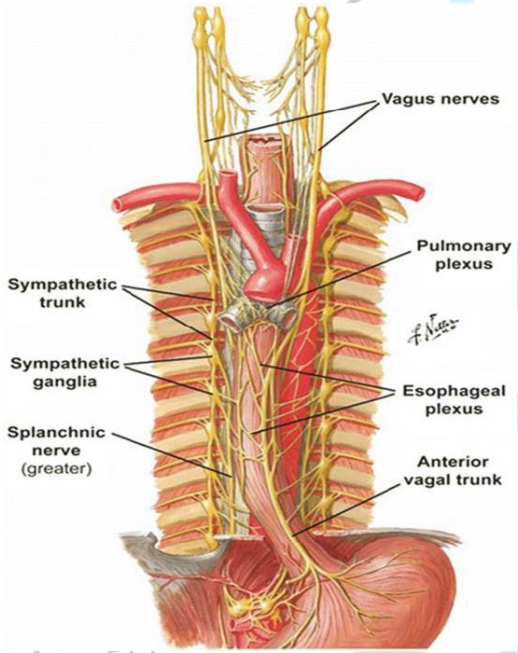
Mediastinal Pleura: As we discussed in the previous section.

Slide 4:



"Inferiorly to the level of the roots of the lungs, the vagus nerves leave the pulmonary plexus and join with sympathetic nerves to form the esophageal plexus."

Let's clarify what the pulmonary plexus is (without going into unnecessary detail):
Pulmonary plexus: "The **pulmonary plexus** is an autonomic **plexus** formed from **pulmonary** branches of vagus nerve and the sympathetic trunk" (refer to the following image). The vagus nerve then leaves this plexus to join other branches from the sympathetic trunk and forms another plexus, the esophageal plexus. This plexus, as you can see, is directly related to the esophagus.



Slide4: "The left vagus lies anterior to the esophagus, and the right vagus lies posterior."

- This one is pretty straightforward. An image for clarification is all you need here.
- Notice how the right vagus nerve curves posteriorly and is now located behind the esophagus.
- The left vagus nerve curves anteriorly and is now located in front of the esophagus.

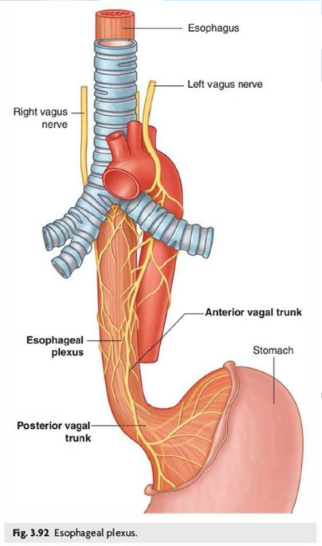
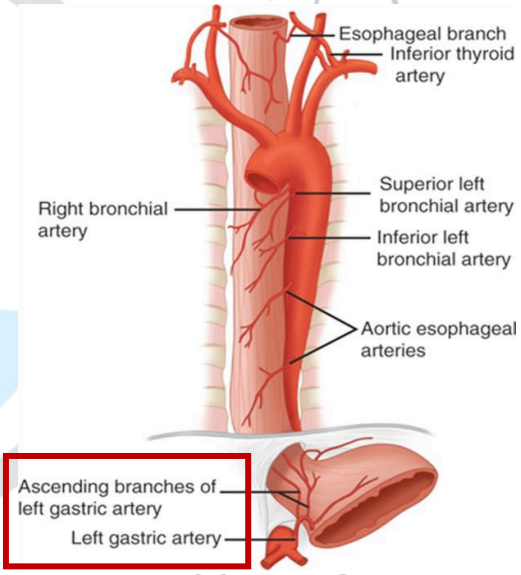


Fig. 3.92 Esophageal plexus.

- The vagus nerves are very loyal friends of the esophagus; they continue to accompany the esophagus along its path, and they even enter the abdomen through the same opening, that's how loyal they are!

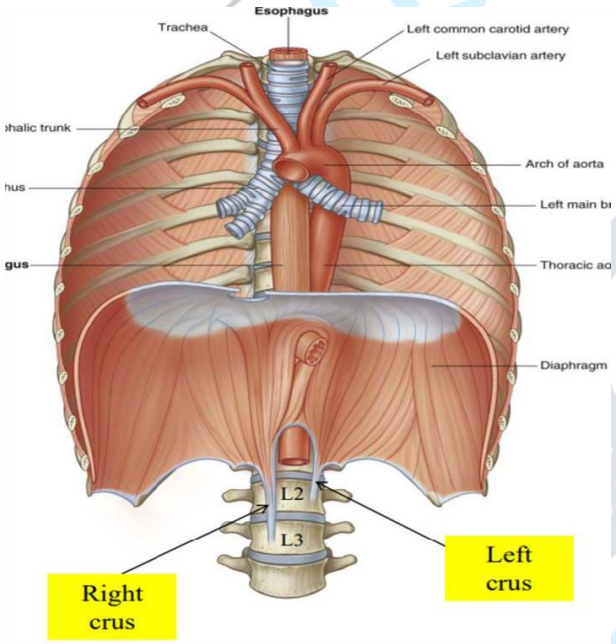
Slide 4: "At the opening in the diaphragm, the esophagus is accompanied by the two vagi, branches of the left gastric blood vessels, and lymphatic vessels."

- As the esophagus pierces the diaphragm, the two vagus nerves take advantage of this opening and enter the abdomen with the esophagus (loyal friends).
- Left gastric blood vessels: (quick background: the gastric artery arises from the celiac artery, which is a branch from the abdominal aorta).
  *We are going to discuss this later in the stomach part.
  Notice how branches of this artery are related to the esophagus.
  We also have a corresponding vein: the left gastric vein (not shown here).



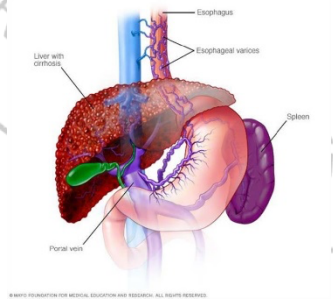
Slide 4: Fibers from the right crus of the diaphragm pass around the esophagus in the form of a sling. In the abdomen, the esophagus descends for about 0.5 in. (1.3 cm) and then enters the stomach

- This one brings back memories from the MSS course, I imagine. Recall that the diaphragm is a muscle, and its muscle fibers originate from several different places. Some of its fibers arise from the lumbar vertebrae, forming the right and left crura (singular: crus).
- Some of the fibers of the right crus ascend upwards and surround the esophagus (acts as a sphincter).



Slide 4: It is related to the left lobe of the liver anteriorly and to the left crus of the diaphragm posteriorly.

- Notice how the left lobe of the liver lies anterior to the esophagus.

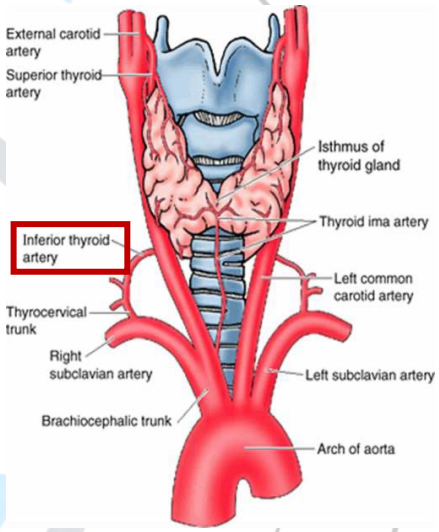


- From the image in the previous section, you can see how the left crus is related to the diaphragm posteriorly.

Blood Supply of the Esophagus

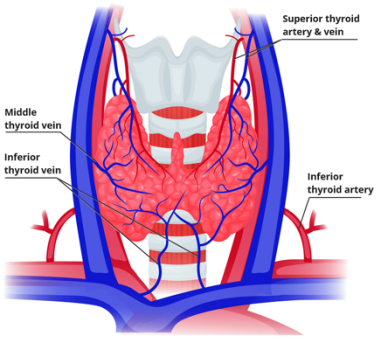
Slide 5: "The upper third of the esophagus is supplied by the inferior thyroid artery, the middle third by branches from the descending thoracic aorta, and the lower third by branches from the left gastric artery"

- Inferior thyroid artery: A branch from the thyrocervical trunk, which arises from the right subclavian artery. It supplies the upper third of the esophagus.
- Branches from the descending aorta supply the middle third of the esophagus.
- The left gastric artery (the one we discussed earlier) supplies the lower third of the esophagus.



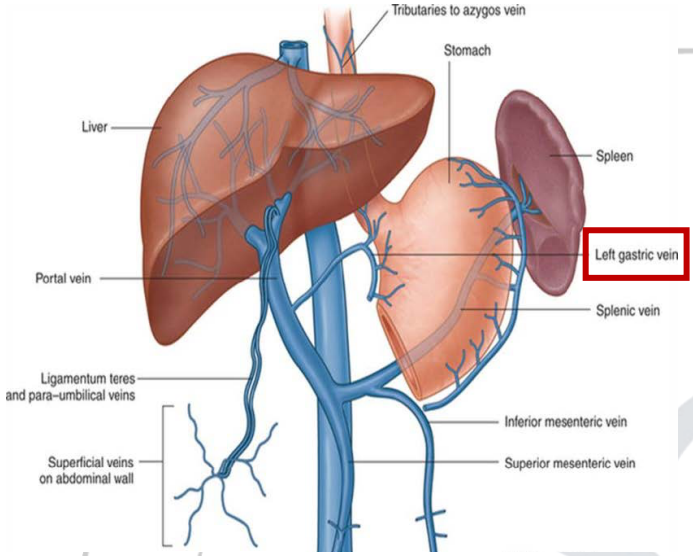
Slide 5: The veins from the upper third drain into the inferior thyroid veins, from the middle third into the azygos veins, and from the lower third into the left gastric vein, a tributary of the portal vein.

- Inferior thyroid veins: These veins can be seen in the area roughly around and below the thyroid gland. The right and left inferior thyroid veins drain into the right and left brachiocephalic veins, respectively, near their junctions with the SVC. They drain the upper third of the esophagus.



- The azygos veins drain the middle third of the esophagus (refer to earlier images to see the azygos vein again).

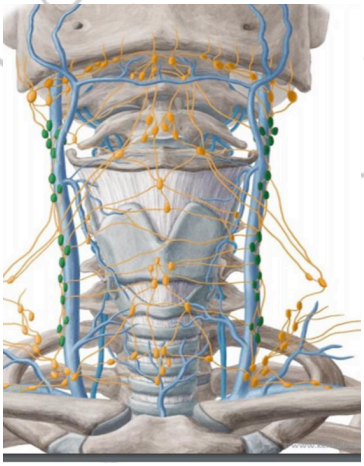
- Left gastric vein: we talked about this vein earlier. It drains the lower third of the esophagus, and then drains into the portal vein.



Lymph drainage and nerve supply of the esophagus

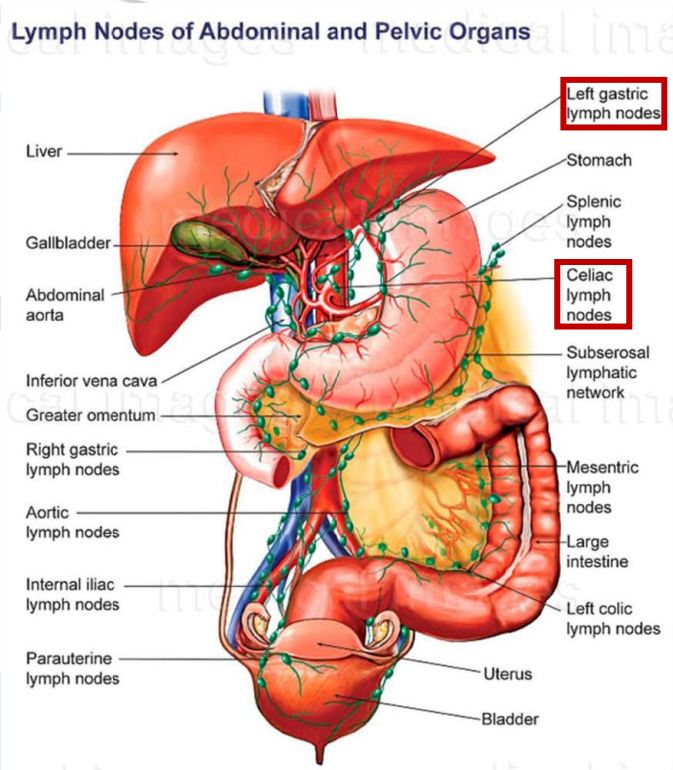
Slide 6: Lymph vessels from the upper third of the esophagus drain into the deep cervical nodes, from the middle third into the superior and posterior mediastinal nodes, and from the lower third into nodes along the left gastric blood vessels and the celiac nodes

- Nothing much to say here. All you need are some images to be able to imagine the locations of the different lymph nodes and which parts of the esophagus they drain.
- Deep cervical lymph nodes: drain the upper third of the esophagus. (In the adjacent image, they are highlighted in green along the IJV (lateral group), and the yellow ones along the midline (median group).



- Superior and posterior mediastinal lymph nodes: drain the middle third of the esophagus. (Knowing their names should be sufficient for now).

- Lymph nodes along the gastric blood vessels and the celiac nodes: drain the lower third of the esophagus.

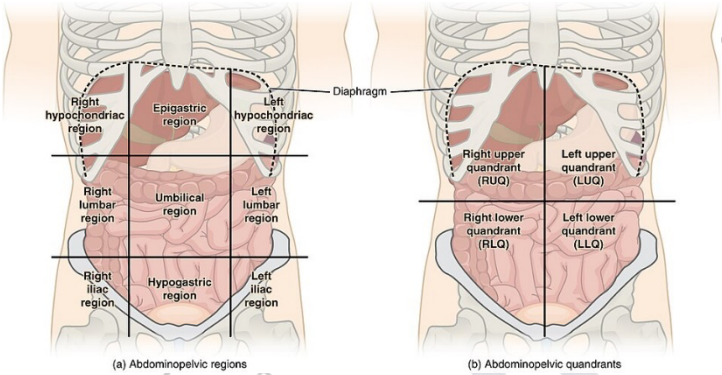


Slide 6: The esophagus is supplied by parasympathetic and sympathetic efferent and afferent fibers via the vagi and sympathetic trunks. In the lower part of its thoracic course, the esophagus is surrounded by the esophageal nerve plexus.

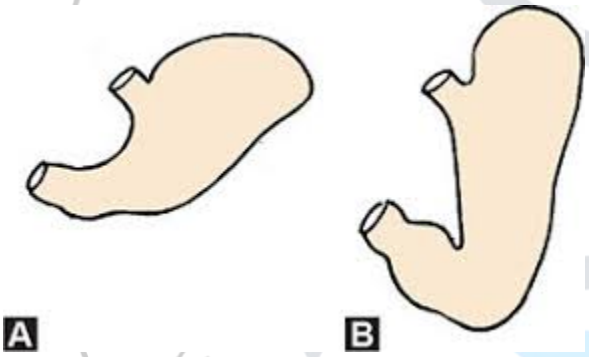
- Very straightforward information.
- Note: Esophageal plexus was discussed previously. Refer to the image.

[Stomach]

- The stomach is a dilated part of the alimentary canal between the esophagus and the small intestine
- The stomach occupies the left upper quadrant mainly in the epigastric region (see the diagram below).



→ Shape of the stomach



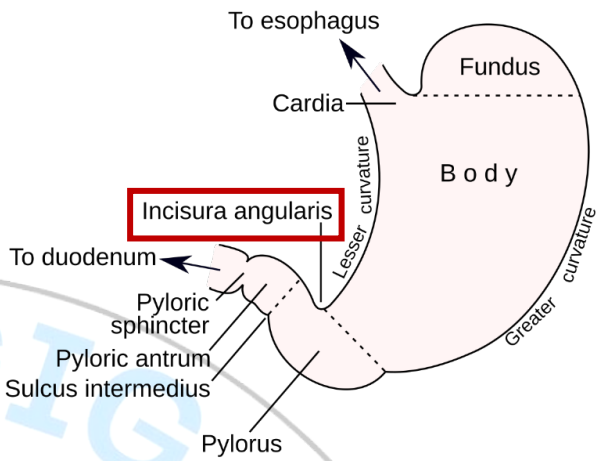
- It is roughly J-shaped (as shown in B)
- Steer horn in obese person (as shown in A).

- Its shape undergoes considerable variation in the same person and depends on:
    1. The volume of its contents
    2. The position of the body
    3. The phase of respiration.

→ Function of the stomach

- It stores food (in adults, it has a capacity of about 1500 ml).
- It mixes the food with gastric secretions to form a semifluid "chyme".
- It controls the rate of delivery of the chyme to the small intestine so that efficient digestion can take place.

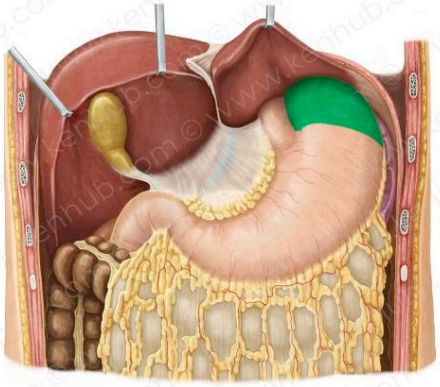
→ Parts of the stomach



The stomach is divided into the following parts:

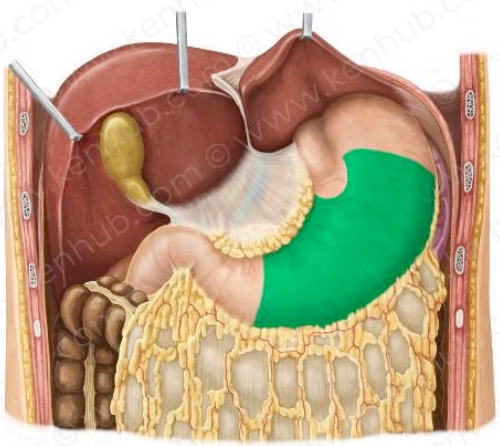
1- Fundus:

- It is dome-shaped and usually full of gas.
- It projects upward and to the left of the cardiac orifice.

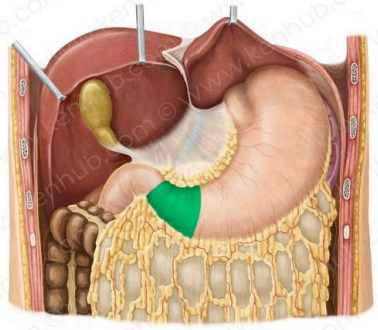


2- Body:

- It extends from the level of the cardiac orifice to the level of the incisura angularis (a constant notch in the lower part of the lesser curvature).



3- Pyloric region

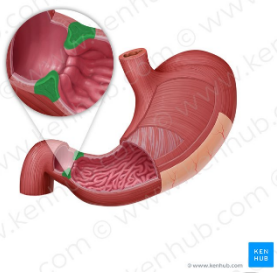


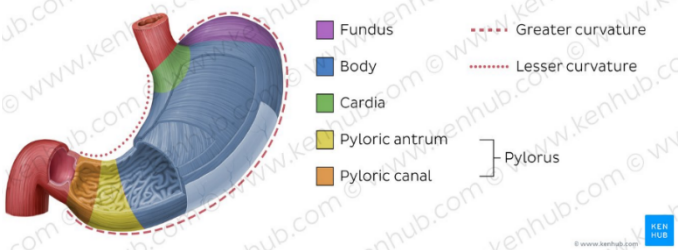
The pyloric region is divided into:

Pyloric antrum:
- This extends from the incisura angularis to the pylorus

Pyloric canal:

Pylorus:
- The most tubular part of the stomach.
- The thick muscular wall is called the pyloric sphincter



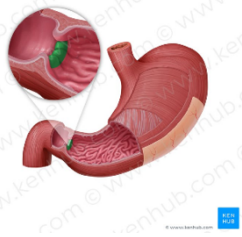


The stomach has two openings, the cardiac and pyloric orifices. Two curvatures, the greater and lesser curvatures. Two surfaces, an anterior and a posterior surface.

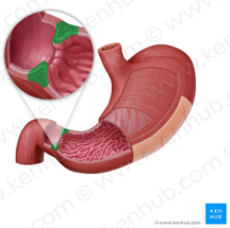
→ Orifices of the stomach

1. Cardiac orifice
- The cardiac orifice is where the esophagus enters the stomach.
- No anatomic sphincter can be demonstrated here.
- A physiological sphincter, however, exists → a physiological mechanism exists that prevents regurgitation of stomach contents into the esophagus.
- Let's discuss the difference between an anatomical sphincter and a physiologic one!
  When we say a sphincter is a physiologic one, we mean there is actually no distinct thickened circular smooth muscle, so closure is maintained by tonic contraction of the lower esophageal sphincter LES muscle mainly.
  On the other hand, when we say that a sphincter is an anatomical one, we mean that there is a well-defined thickened ring of circular smooth muscle.
- The site of cardiac orifice:
  7^{th} left costal cartilage
  1 inch to lt. of midline
  45 cm from the incisors in the oral cavity
  10 cm from the anterior abdominal wall

2. Pyloric orifice
- Present at the end of the pyloric canal:
  on the level of L1
  1 inch to the rt. of the midline.



- The circular muscle coat of the stomach is much thicker here and forms the anatomic and physiologic pyloric sphincter



- The pyloric sphincter position can be recognized by a slight constriction on the surface of the stomach (the pylorus lies on the transpyloric plane).
- The pyloric sphincter controls the outflow of gastric contents into the duodenum.

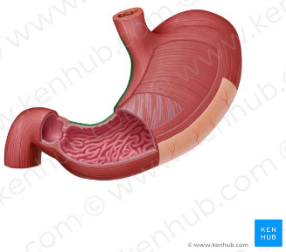
- The sphincter receives
  motor fibers from the sympathetic system
  &
  inhibitory fibers from the vagus nerve (parasympathetic).

- The pylorus is controlled by:
  → local nervous structures: for example, the stretching of the stomach (due to filling) will stimulate the myenteric nerve plexus, which leads to the relaxation of the sphincter

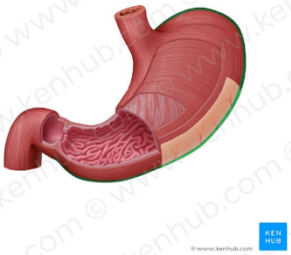
  → and hormonal influences from the stomach and duodenal walls.

→ Curvatures of the stomach

1. The lesser curvature
- Extends from the cardiac orifice to the pylorus and forms the right border of the stomach.

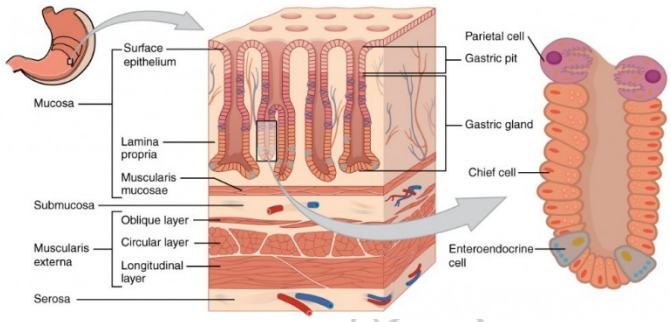


2. The greater curvature
- Much longer than the lesser curvature
- Extends from the left of the cardiac orifice, over the dome of the fundus, and along the left border of the stomach to the pylorus.



A Glimpse into the Histology of the Stomach

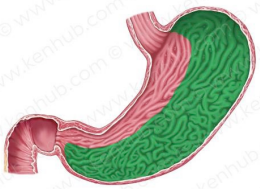
Here we are going to talk very briefly about the histology of the stomach; further extensive (and by extensive, I mean EXTENSIVE) explanation can be found in the histology lectures, good luck studying them :)



For now, know that the stomach mainly has 4 layers: the **mucosa, submucosa, muscularis externa,** and the **serosa**.

1. **Mucosa**
   Just to make things clear from the start and to save you time and effort, the mucosa has 3 layers (the surface epithelium, the lamina propria, and the *muscularis mucosa*)
   I don't want you to confuse the *muscularis mucosa* of the mucosa with the third main layer, which is the **muscularis externa**!

   - The mucous membrane of the stomach is thick and vascular and is thrown into numerous folds, or rugae, mainly longitudinal in direction
   *The folds flatten out when the stomach is distended.



2. **Submucosa**
- It contains the submucosal plexus (high yield)

3. **Muscularis externa**
- It contains the myenteric plexus (high yield)
- The muscular wall of the stomach contains longitudinal fibers (outer surface), circular fibers (inner surface), and oblique fibers.
  *Shown in the following page from outer → inner.

Outer

Inner

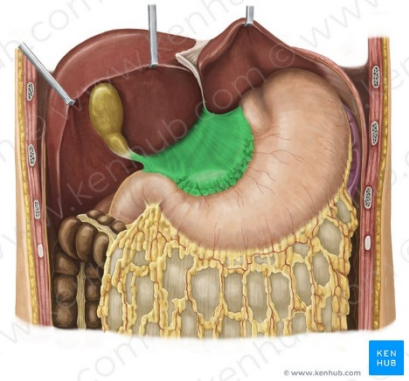
4. The serosa

- It consists of the visceral peritoneum that covers the stomach.

Peritoneum of the stomach

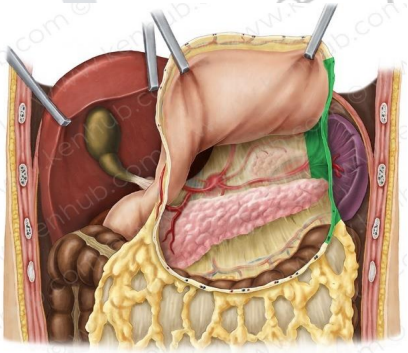
- We have two layers of peritoneum: the parietal peritoneum and the visceral peritoneum. And when we say that a structure is an intraperitoneal structure, we mean that the visceral layer completely covers it from all sides, and this is the case with the stomach. The stomach is an <u>intraperitoneal</u> structure!

- The visceral peritoneum leaves the lesser curvature as the lesser omentum (shown in green).

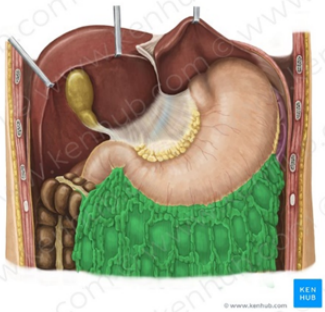


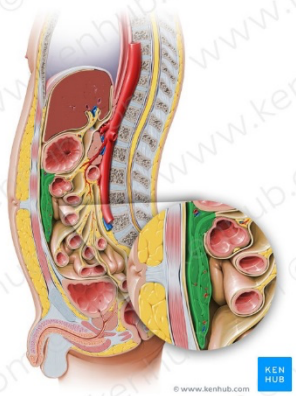
- And leaves the greater curvature as the gastrosplenic ligament and the greater omentum.

- The gastrosplenic ligament extends from the upper part of the greater curvature to the spleen.

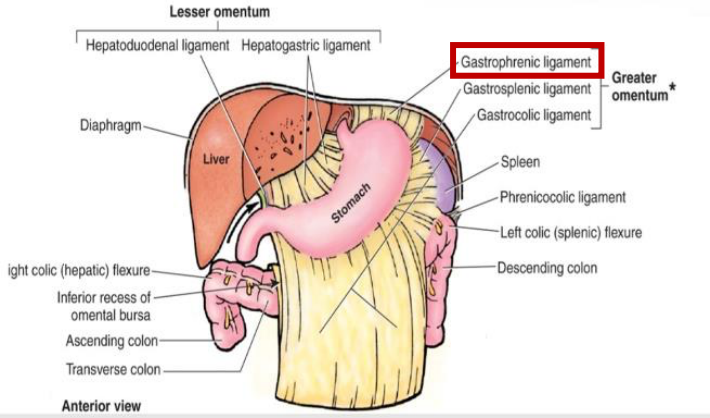


- The greater omentum extends from the lower part of the greater curvature to the transverse colon (meaning it descends then reascends again to attach to the transverse colon.





- Gastrophrenic ligament between the fundus and the diaphragm.
    *In the diagram below, you'll see that each of the lesser and greater omentums consist of different ligaments; this is out of the scope of the lecture, so no need to pay it any attention.



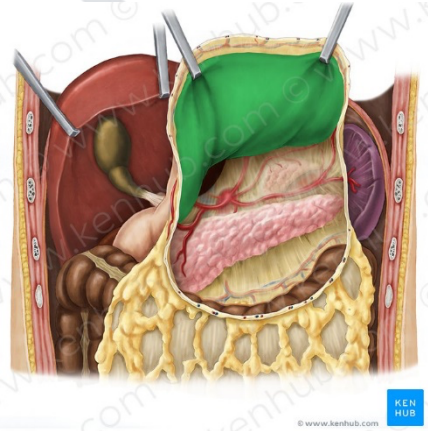
Relations of the Stomach

*For this part, you need a big imagination.

→ **Anterior-superior**
- The anterior abdominal wall
- Left costal margin
- Left pleura and lung
- Diaphragm
- Left lobe of the liver

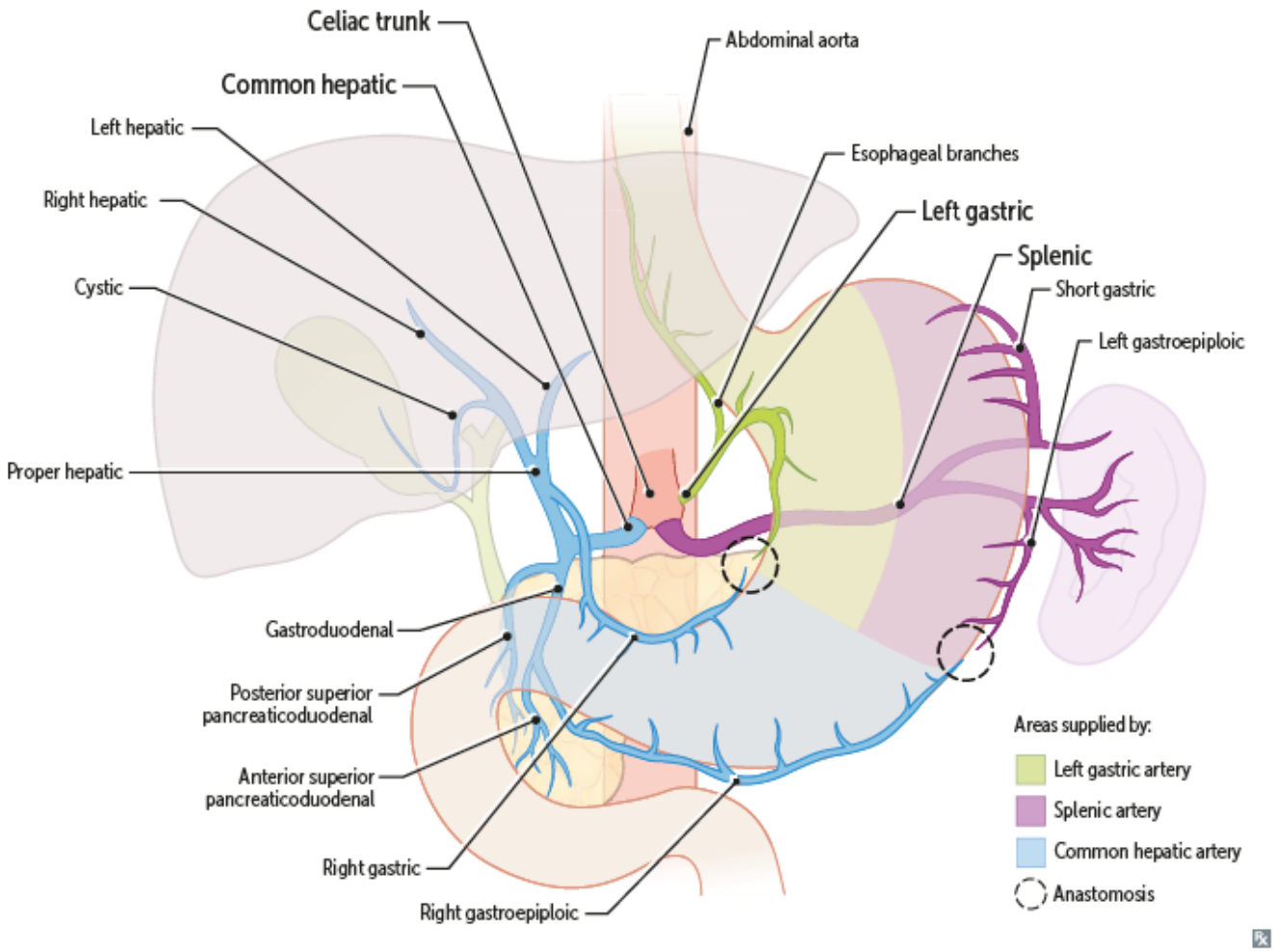
→**Posteriorly = stomach bed**
- The lesser sac
- Lt. crus of the diaphragm
- Spleen
- Left suprarenal gland
- Upper part of the left kidney
- Splenic artery
- Body of the pancreas
- Transverse mesocolon
- Transverse colon

*The image below shows some of the posterior relations, after we've raised the stomach.



Blood Supply of The Stomach

*Very high yield, especially clinically!



- The stomach is supplied by the celiac trunk, a.k.a. celiac artery.
- The celiac trunk (which is 1 cm long) arises from the front of the abdominal aorta and is located at the level of T12 to L1 above the pancreas.
- Relations of the celiac artery:
  - → On each side: celiac ganglia + lymph nodes
  - → Crus of diaphragm and lumbar nerves
  - → Its branches to the foregut

- Main distribution:
  - → **Left gastric artery**
  - → **Splenic artery**
  - → **Common hepatic artery**

→ Left gastric artery

- Arises from the celiac artery
- It passes upward and to the left to reach the esophagus, then descends along the lesser curvature of the stomach.
- It supplies the lower third of the esophagus and the upper right part of the stomach (as highlighted in the image above in green).

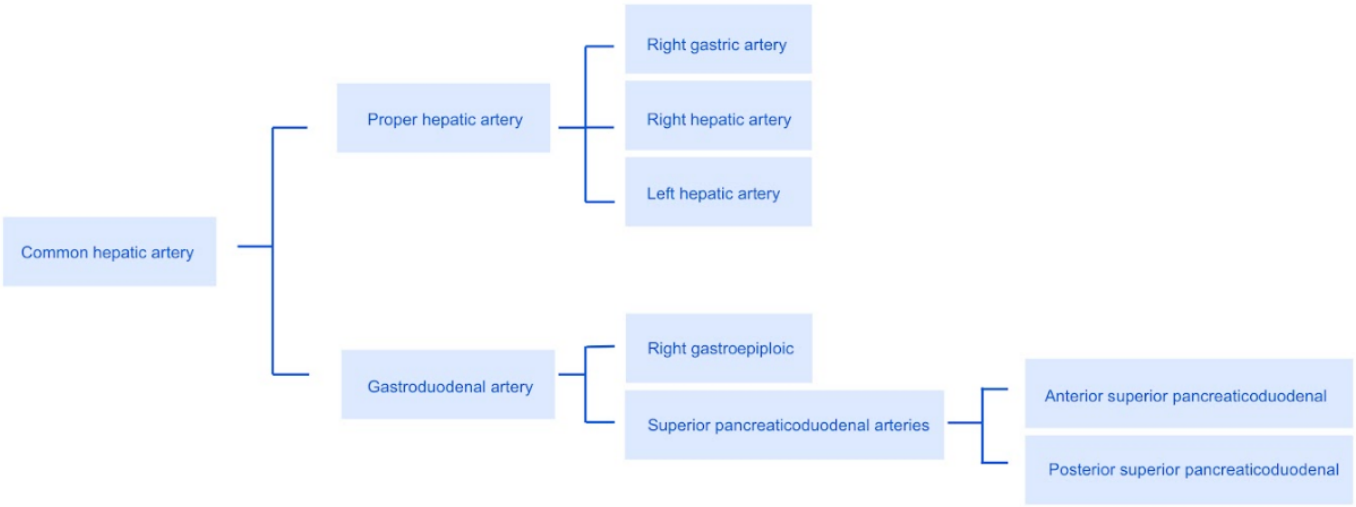
→ Splenic artery

- It gives the left gastroepiploic and the short gastric.

***Now the easy part's over, I need you to focus really well! Things are going to get a tad bit more difficult.**

➔ Common hepatic artery

*Study the diagram below very carefully and refer to the image while doing so!



Now, after we have this base, we can go on and talk about the arteries that supply the stomach.

1. The left gastric artery

- We already talked about it.

2. The right gastric artery

- Which arises from the proper hepatic artery at the upper border of the pylorus and runs to the left along the lesser curvature.
- It supplies the lower right part of the stomach.

3. The short gastric arteries

- Arise from the splenic artery (5-7 arteries) in the gastrosplenic ligament.
- Pass upward in the gastrosplenic to supply the fundus.

4. The left gastroepiploic artery

- Arises from the splenic artery before the hilum of the spleen.
- Passes forward in the gastrosplenic ligament.
- Supply the stomach along the upper part of the greater curvature in the greater omentum.

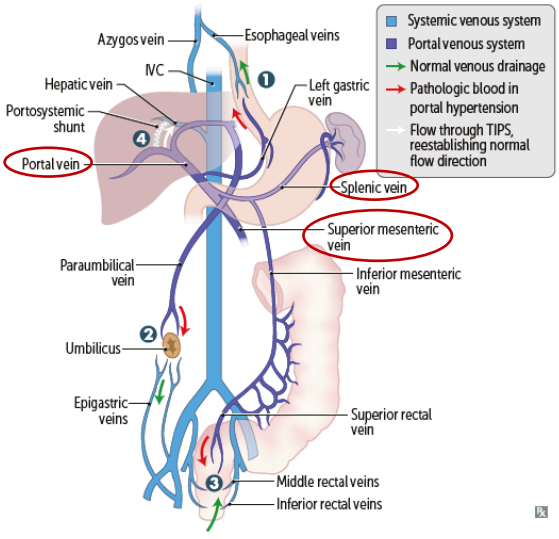
5. The right gastroepiploic artery

- Arises from the gastroduodenal branch of the hepatic artery.
- It passes to the left and supplies the stomach along the lower part of the greater curvature in the greater omentum.

Venous drainage of the stomach

- The veins drain into the portal circulation
- The left and right gastric veins drain directly into the portal vein
- The short gastric veins and the left gastroepiploic veins join the splenic vein
- The right gastroepiploic vein joins the superior mesenteric vein (which meets the splenic vein behind the neck of the pancreas to form the portal vein).

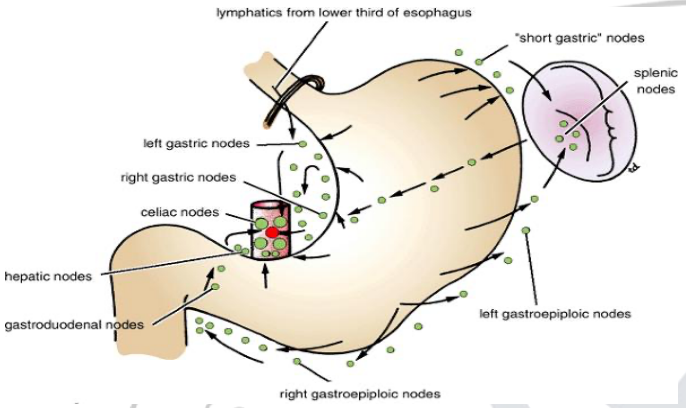
*This image has more information than we need here, but I thought I'd include it so you can refer to it later in the future. For now, just study the circled structures.



Lymphatic drainage of the stomach

It follows the arteries of the stomach
- The left and right gastric nodes
- The left and right gastroepiploic nodes
- The short gastric nodes

All lymph from the stomach eventually passes to the celiac nodes located around the root of the celiac artery on the posterior abdominal wall.

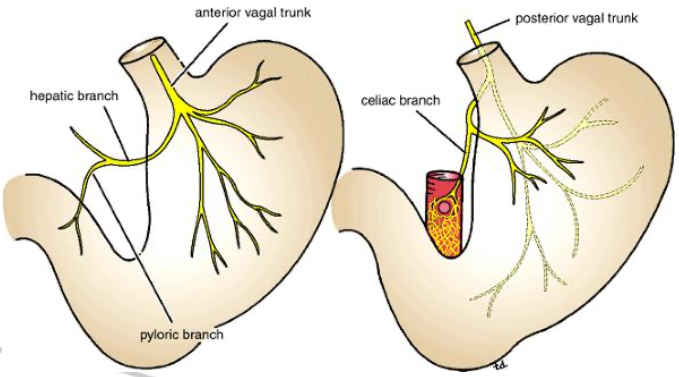


Nerve supply for the stomach

The nerve supply includes:
→ **Sympathetic fibers** derived from the celiac plexus
The sympathetic innervation of the stomach carries a proportion of pain sensation.

→ **Parasympathetic fibers** from the right and left vagus nerves.
The parasympathetic vagal fibers are secretomotor to the gastric glands and motor to the muscular wall of the stomach (peristaltic movement).

The pyloric sphincter receives motor fibers from the sympathetic system and inhibitory fibers from the vagus nerves (as we already mentioned).



→ The anterior vagal trunk
(mainly from the left vagus nerve distribution)
1. The anterior surface of the stomach.
2. A large hepatic branch passes up to the liver
3. Anterior nerve of Laterjet → pylorus

→ The posterior vagal trunk
(mainly from the right vagus nerve distribution)
1. Mainly the posterior wall of the stomach.
2. Anterior wall of the body of the stomach
3. Celiac branch → small intestine + as far as to splenic flexure + pancreas
4. Posterior nerve of Latarjet → pylorus

Clinical notes

Peptic ulcer: could be gastric or duodenal, and is mostly caused by *Helicobacter pylori.* The two types can be differentiated by their relation to eating. If the pain is relieved by eating = duodenal and vice versa. Think about why that makes sense!

Truncal vagotomy: sectioning the vagus nerves below the diaphragm around the esophagus (to treat peptic ulcers, for example!).

Highly selective vagotomy: cutting all branches of the vagi except for the latarjet nerve

Pyloroplasty (drainage) = gastro-jejunostomy
When denervating the stomach (such as in the above procedure), we have no way of emptying the stomach; we've paralyzed it. A pyloroplasty allows food to leave with the help of gravity.

Gastroscopy: When we insert a scope into the stomach for diagnostic or therapeutic purposes.

The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

The Small Intestine

Written by: Sereen Draghmeh

Edited by: Ghada T. Alzoubi

Reviewed by: Amr Abdallah

[Overview]

➔ **Outline of the Peritoneum we will cover:**

1) **Duodenum**
   a. Site of the Duodenum
   b. Parts of the Duodenum and their Relation
      i. First Part
      ii. Second Part
      iii. Third Part
      iv. Fourth Part
   c. Vascular Supply + Nerve Supply of the
2) **Jejunum and Ileum**
   a. Structure of the small Intestine
   b. Difference between Jejunum and Ileum
   c. Vascular Supply + Nerve Supply
3) **Mesentery of the Small Intestine**
   a. Contents
4) **Congenital Anomaly of the Small Intestine**
   a. Meckel's Diverticulum

[Duodenum]

➔ **General Description:**

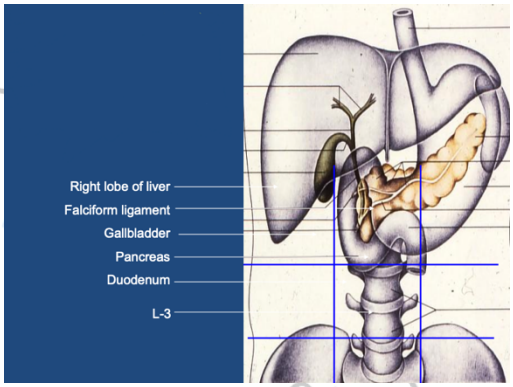
- The duodenum is a C-shaped concave tube
- About 10" in length.
- It joins the stomach to the jejunum.
- It curves around the head of the pancreas to the left and backwards.
- It is important because it receives the opening of the bile and pancreatic ducts.
- The Duodenum extends from the pylorus to the jejunum.
- It's divided into 4 parts

➔ **Peritoneal Relations**

- Most of the duodenum is retroperitoneal except the 1st inch & last inch
- This short segment(1st inch) has the lesser omentum on its upper border, the greater omentum on its lower border, and the lesser sac posterior to it

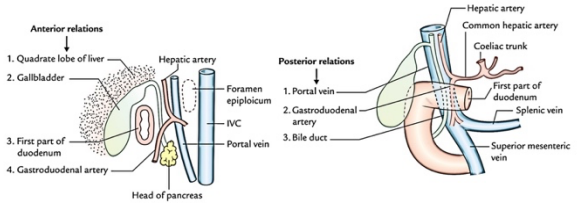
Site of the Duodenum

- The duodenum is situated in the epigastric and umbilical regions
- for purposes of description, is divided into four parts



Parts of the Duodenum & Their Relations

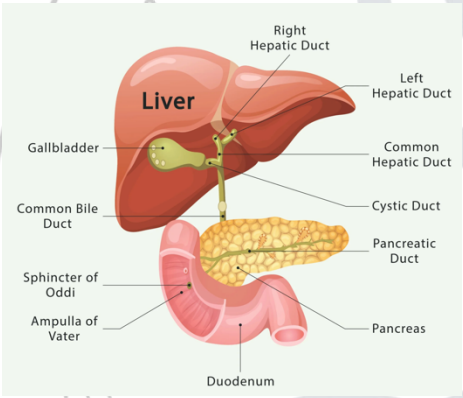
1. **First Part**
   a. <u>Length</u>
      i. 2 inches long
   b. <u>Location</u>
      i. Begins from the pyloduodenal junction
      ii. At the level of the transpyloric line
      iii. Runs upwards and backwards at the level of the 1st Lumbar vertebrae 1 inch to the right
   c. <u>Relations</u>
      i. **Anterior** : Liver (Quadratus lobe) + Gall Bladder
      ii. **Superior**: The Epiploic Foramen
      iii. **Posterior**: Lesser Sac + Gastroduodneal Artery + Bile Duct + Portal Vein + IVC
      iv. **Inferior**: Head of Pancreas



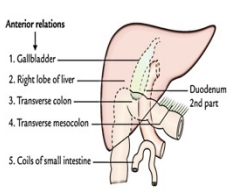
2. Second Part

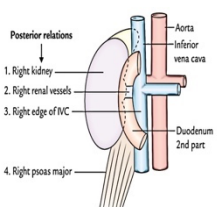
a. Length:
   i. 3 inches long

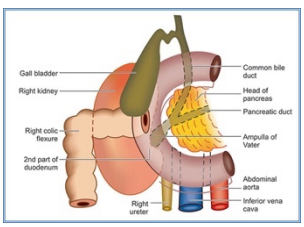
b. Location:
   i. Runs downward vertically on the right side
   ii. In front of the right kidney
   iii. Next to the 3rd and 4th vertebrae
   iv. Halfway through it, the bile duct and the main pancreatic duct pierce the medial wall and then form the ampulla that opens in the major duodenal papilla
   v. The accessory pancreatic duct (if present) opens in the minor duodenal papilla more superiorly



c. Relations
   i. **Anterior**: Gallbladder Fundus + Right Liver Lobe + Transverse Colon + Coiled Small Intestine
   ii. **Posterior**: Right Kidney Hilum + Right Ureter
   iii. **Lateral**: Right Colic Flexure + Ascending Colon + Right Liver Lobe
   iv. **Medial**: Pancreatic Head + Bile and Pancreatic Ducts





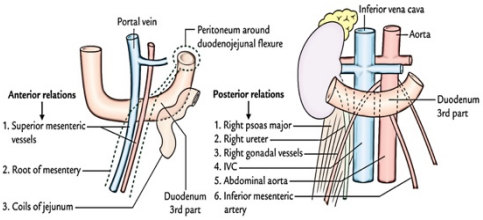


3. Third Part

a. Length:
   i. 4 inches long

b. Location:
   i. Runs horizontally to the left
   ii. On the Subcostal Plane
   iii. Runs in the Vertebral Column
   iv. Under the lower margin of the Pancreatic Head
   v. Above the coils of the Jejunum

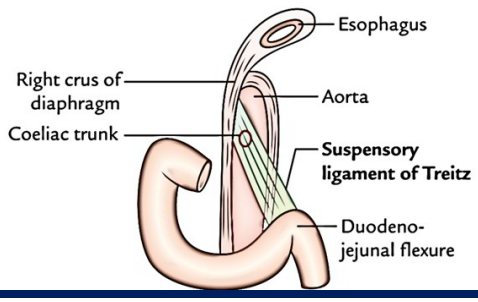
c. Relations:
   i. **Anterior**: Root of Mesentery of the Small Intestine + Superior Mesenteric Vessels contained within the Mesentery + Coils of Jejunum
   ii. **Posterior**: Right Ureter + Right Psoas Muscle + IVC + Aorta
   iii. **Superior**: Pancreatic Head
   iv. **Inferior**: Coils of Jejunum



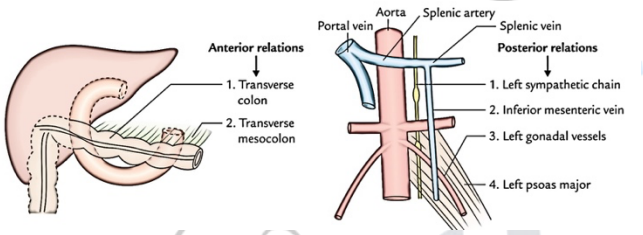
4. Fourth Part

a. Length:
   i. 1 inch Long

b. Location:
   i. Runs upwards to the left
   ii. Ends in the duodenojejunal junction at the level of the 2nd Lumbar vertebrae, 1 inch to the left
   iii. The junction (flexure) is held in position by the Ligament of Treitz, which is attached to the Right Crus of the Diaphragm (Duodenal Recess)

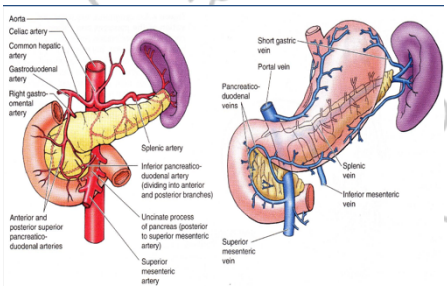


c. Relation:
   i. **Anterior**: Beginning of the Root of Mesentery + Coils of Jejunum
   ii. **Posterior**: Left Psoas Major + Sympathetic Chain + Left Margin of Aorta
   iii. **Superior**: Uncinate Process of the Pancreas



Vascular and Nerve Supply

1. **Arterial Supply**
   a. Upper Half (first part + upper ½ of 2nd part)
      i. Superior Pancreaticoduodenal Artery → a branch of the Gastroduodenal Artery
   b. Lower Half (lower ½ of second part + 3rd + 4th part)
      i. Inferior Pancreaticoduodenal Artery → branch of the Superior Mesenteric Artery
2. **Venous Drainage**
   a. The Superior Pancreaticoduodenal Vein drains into the Portal Vein
   b. The Inferior Vein joins the Superior Mesenteric Vein

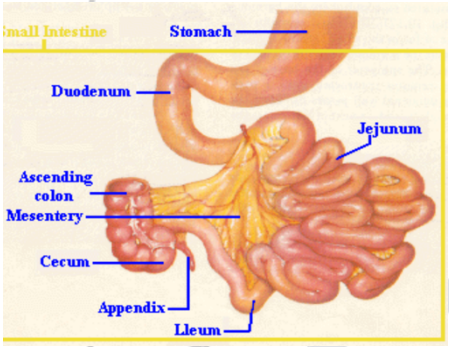


3. **Lymphatic Drainage**
   a. The Lymph vessels follow the arteries
   b. Drains Upwards
      i. Via the Pancreaticoduodenal nodes → the Gastroduodenal nodes → Celiac nodes
   c. Drains Downwards
      i. Via the Pancreaticoduodenal nodes → the Superior Mesenteric nodes around the origin of the Superior Mesenteric Artery
4. **Nerve Supply**
   a. Sympathetic nerve
   b. Parasympathetic Nerves from
      i. The Celiac Plexus
      ii. Superior Mesenteric Plexus

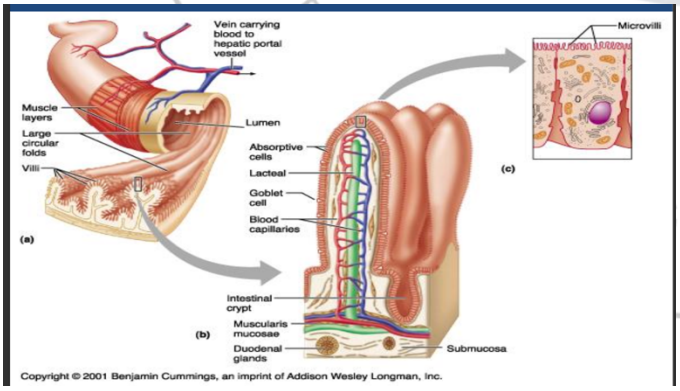
[Jejunum and Ileum]

➔ General Description:

- Length:
  - The jejunum and Ileum measure about 20 ft (6m) long
- Upper 2/5ths is the Jejunum and the lower 3/5ths is the Ileum
- Each has a distinctive feature
- There is a gradual change from one to another
- Location:
  - The Jejunum begins at the duodenojejunal flexure
  - The Ileum ends at the Ileocecal Junction
  - The coils of the Jejunum and Ileum are freely mobile and are attached to the posterior abdominal wall by a fan-shaped fold of peritoneum known as the mesentery of the small intestine



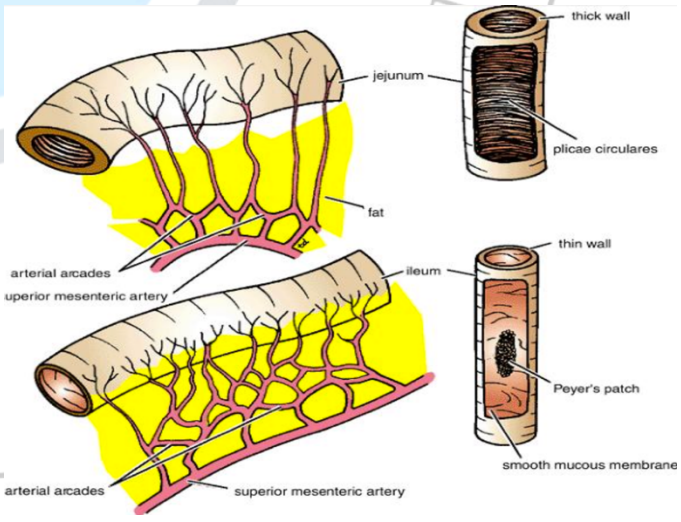
Structure of the Villi in the Small Intestine



Difference between Jejunum and Ileum

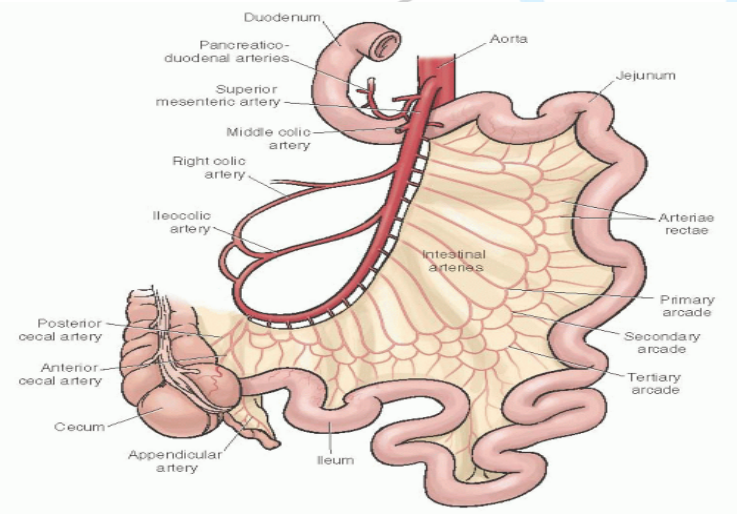
	jejunum	Ileum
length	Proximal 2/5	Distal 3/5
site	in the upper part of the peritoneal cavity below the left side of the transverse mesocolon	in the lower part of the cavity and in the pelvis
wall	thicker wall& redder	Thinner & less redder
Arcades in mesentery	-simple ,only one or two arcades -with long infrequent branches -Long vase recta	numerous short terminal vessels arise from a series of three or four or even more Arcade - Short vase recta
Fat in mesentery	- the fat is deposited near the root - it is scanty near the intestinal wall - Less in amount →appear window	- the fat is deposited throughout mesentery - Big amount - No window appear

	jejunum	Ileum
Diameter	wider	smaller
villi	numerous	Less numerous
Plicae circularis(the permanent enfolding of the mucous membrane& submucosa	They are: 1- larger 2- more numerous 3- closely set	they are: 1- smaller 2- more widely separated 3- in the lower part they are absent .
Lymphatic follicles	No or few	Aggregations of lymphoid tissue (Peyer's patches) are present in the mucous membrane

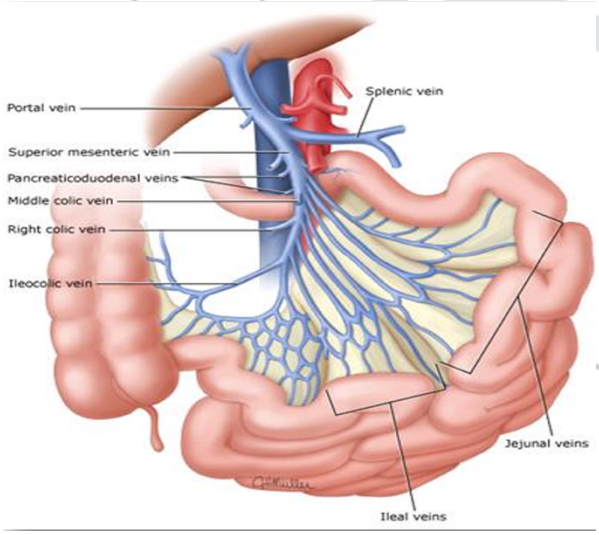


Vascular and Nerve Supply

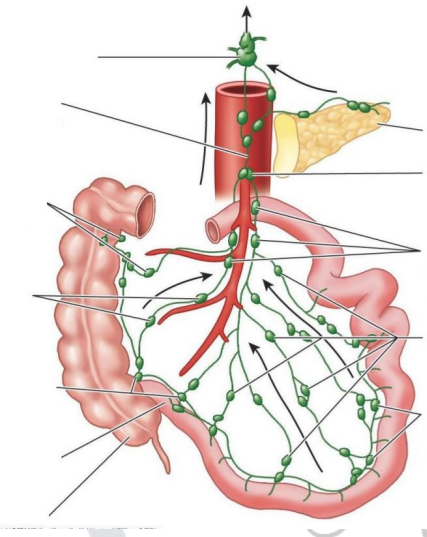
1. **Arterial Supply**
    a. From branches of the Superior Mesenteric Artery
    b. The Intestinal branches arise from the left side of the artery and run in the mesentery to reach the gut
    c. They anastomose with one another to form a series of arcades
    d. The lowest part of the Ileum is also supplied by the Ileocolic artery



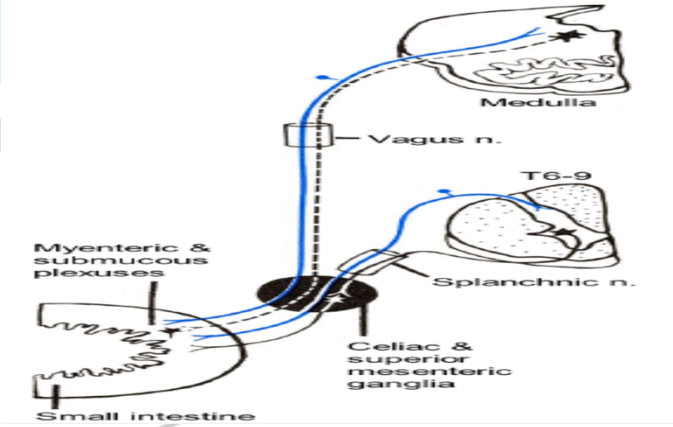
2. **Venous Drainage**
    a. The veins correspond to the branches of the Superior Mesenteric artery
    b. Drain into the Superior Mesenteric Vein



3. **Lymphatic Drainage**
    a. The lymph vessels pass through many intermediate Mesenteric nodes
    b. Finally reach the superior mesenteric nodes → around the origin of the Superior Mesenteric Artery



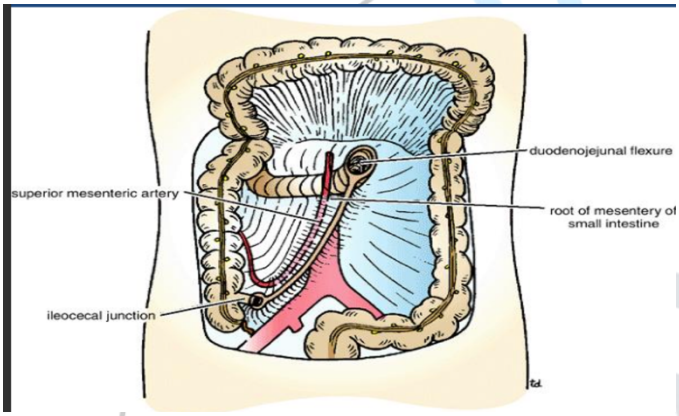
4. **Nerve Supply**
    a. The nerves are derived from the Sympathetic and Parasympathetic (Vagus)
    b. Nerves from the Superior Mesenteric Plexus



[Mesentery of the Small Intestine]

➔General Description

- Fan-shaped fold of peritoneum
- The long free edge of the fold encloses the mobile Intestine
- The short root of the fold is continuous with the parietal peritoneum on the posterior abdominal wall
- Along a line that extends downwards and to the right from the left side of the second Lumbar Vertebra to the region of the right Sacroiliac Joint



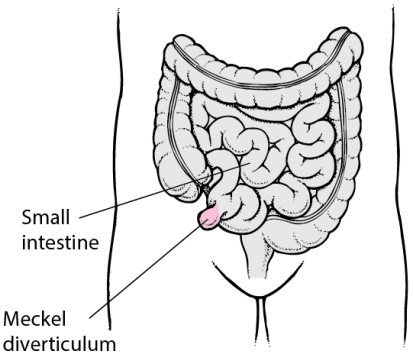
Contents of the Mesentery

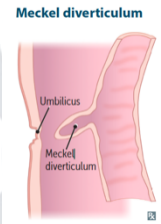
- The branches of the Superior Mesenteric Artery and Vein
- Lymphatic Vessels and Lymphatic Nodes
- Nerves

[Congenital Anomaly of the Small Intestine]

Meckel's Diverticulum

- A congenital anomaly of the Ileum
- Presents in 2% of people
- 2 feet from the Ileocecal Junction
- 2 inches long
- Contains gastric and Pancreatic tissue
- Remains of the Vitelline Duct of the Embryo





True diverticulum. Persistence of the vitelline (omphalomesenteric) duct. May contain ectopic acid–secreting gastric mucosa and/or pancreatic tissue. Most common congenital anomaly of GI tract. Can cause hematochezia/melena (less common), RLQ pain, intussusception, volvulus, or obstruction near terminal ileum.
Diagnosis: ^{99m}Tc-pertechnetate scan (also called Meckel scan) for uptake by heterotopic gastric mucosa.

The rule of 2's:
2 times as likely in males.
2 inches long.
2 feet from the ileocecal valve.
2% of population.
Commonly presents in first 2 years of life.
May have 2 types of epithelia (gastric/pancreatic).

The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

The Large Intestine

Written by: Sereen Draghmeh

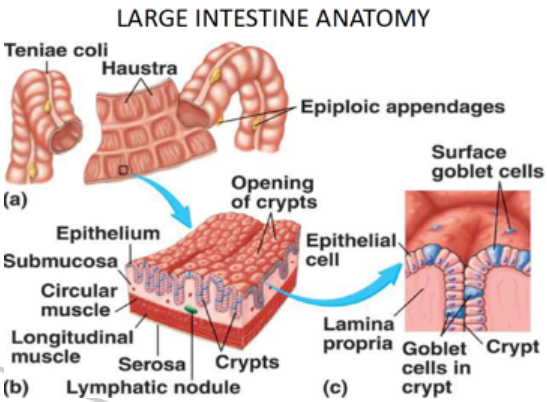
Edited by: Bdour Abdallat

Reviewed by: Amr Abdallah

[Overview]

➔ **Outline:**

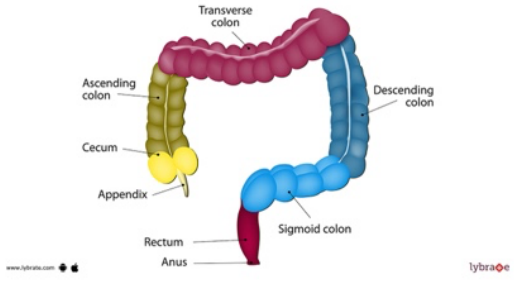
1) **Large Intestine**
2) **Cecum**
3) **Appendix**
4) **Ascending Colon**
5) **Transverse Colon**
6) **Descending Colon**



[Large Intestine]

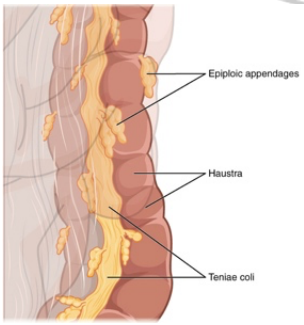
➔ **Anatomy:**

- Extends from the Ileocecal valve to the anus
- Length: 1.4m-2.5m = 5 feet
- Regions
  - Cecum: 2.5-3 in
  - Appendix: 3-5 in
  - Colon
    - Ascending: 5 in
    - Transverse: 15 in
    - Descending: 10 in
    - Sigmoid: 10-15 in
  - Rectum: 5 in
  - Anal Canal: 4 cm



➔ **General Features:**

- Sacculation = Haustra
- Taenia coli
  - Three separate longitudinal ribbons of smooth muscle span the colon.
    - except: appendix and rectum
- Appendices epiploica
  - Adipose structures protruding from the serosal surface of the colon
    - except: appendix, cecum, and rectum



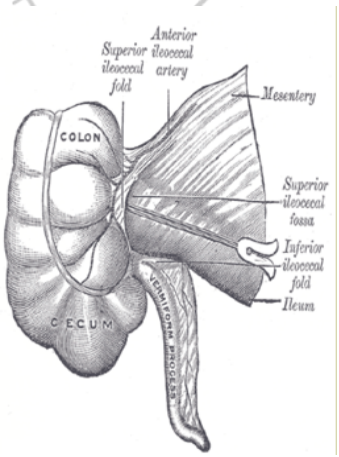
[Cecum]

➔ **General Features**

- It is a blind-ended pouch.
- Site:
  - Situated in the right iliac fossa, above the lateral ½ of the inguinal ligament.
- Size:
  - It is about 3 inches in diameter.
- Completely covered with peritoneum.
- It possesses a considerable amount of mobility, although it does not have a mesentery.

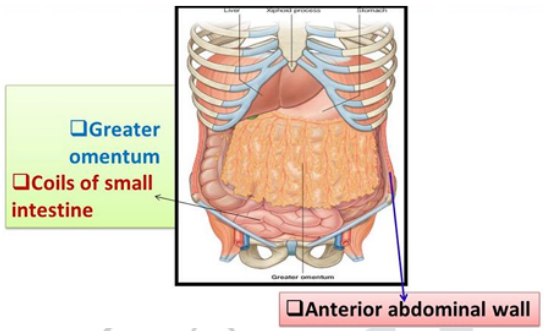
Attachments

- It's attached to:
  - Ascending colon (superiorly)
  - Appendix (posteromedially)
  - Ileum (medially)
- The presence of peritoneal folds in the vicinity of the cecum creates:
  - The superior ileocecal recesses
  - The inferior ileocecal recesses
  - The retrocecal recesses
- The longitudinal muscles are restricted to the three flat bands, the tinea coli, which converge at the base of the appendix and provide it with a complete longitudinal muscle coat

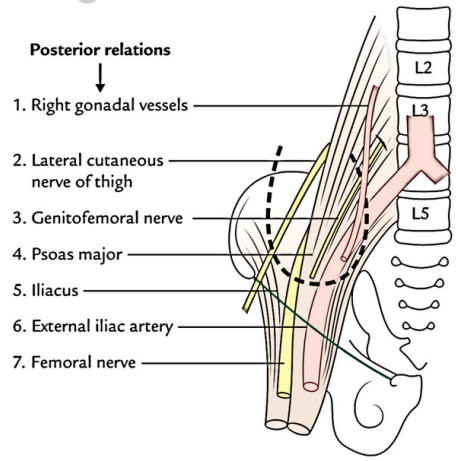


Relations

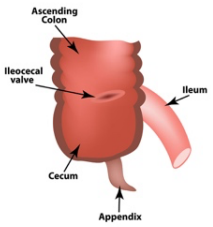
- **Anteriorly:**
  - Coils of the small intestine
  - The greater omentum
  - The anterior abdominal wall in the right iliac region



- **Posteriorly:**
  - The psoas and the iliacus muscles
  - The femoral nerve
  - External iliac vessels
  - The lateral cutaneous nerve of the thigh.
  - Postero-medially → the appendix usually (variable position, most common → retrocecal).
-



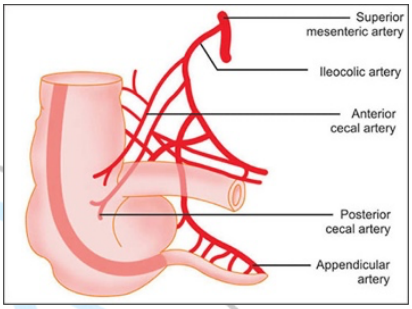
- **Medially:**
  - Small intestine (ileum)



Vascular, Nerve Supply, and Lymphatic Drainage

➔ **Arterial Supply**

- Anterior and posterior cecal arteries → branches of the superior mesenteric artery



➔ **Venous Drainage**

- The venous drainage corresponds to the arteries and drains into the superior mesenteric veins

➔ **Nerve Supply**

- Branches from the sympathetic and parasympathetic (Vagus) nerves from the superior mesenteric plexus

➔ **Lymphatic Drainage**

- The lymph vessels pass through several mesenteric nodes to finally reach the superior mesenteric nodes

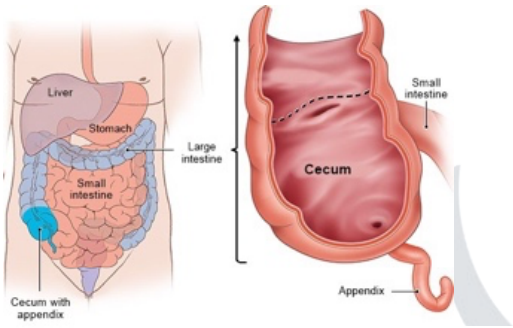
Ileocecal Valve

- A rudimentary structure acting as a physiological (not anatomical) sphincter that helps prevent regurgitation of cecal contents into the ileum.
- Consists of two horizontal folds of mucous membrane.
- Project around the orifice of the ileum.
- The circular muscle of the lower end of the ileum (called the “ileocecal sphincter” by physiologists) serves as a sphincter and controls the flow of contents from the ileum into the colon.
- The smooth muscle tone is reflexively increased when the cecum is distended; the gastrin hormone (produced by the stomach), on the other hand, causes relaxation of the muscle tone.

[Appendix]

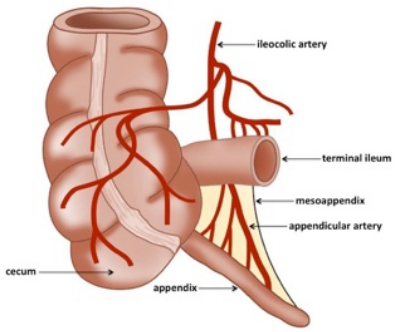
➔ General Features

- It is a narrow, muscular tube containing a large amount of lymphoid tissue.
- It varies in length from 3 to 5 inches (2-22 cm).
- The base is attached to the posteromedial surface of the cecum about 1 inch (2.5 cm) below the ileocecal junction.
- The remainder of the appendix is free.



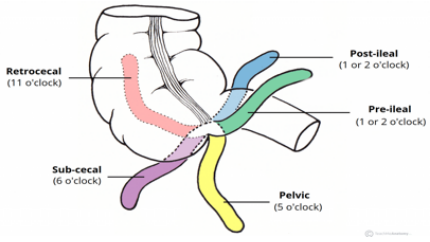
➔ Peritoneum

- It is completely covered by peritoneum, which is attached to the mesentery of the small intestine by a short mesentery of its own, the mesoappendix.
- The mesoappendix contains the appendicular vessels and nerves.



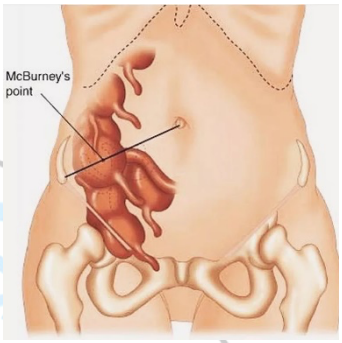
Position

- The appendix lies in the right iliac fossa, and in relation to the anterior abdominal wall:
  1. Retrocecal in retrocaecal recess behind cecum → in 74% of people.
  2. Pelvic: in the pelvis related to rt. ovary and uterine tube → in 21% of people.
  3. Subcaecal: below cecum → in 3.5%
  4. Preileal: in front of the ileum → 1%
  5. Postileal: behind the ileum → 0.5%



Surface Anatomy = McBurney's Point

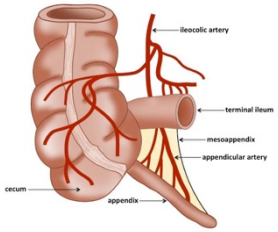
- Its base is situated one-third of the way up the line joining the right anterior superior iliac spine to the umbilicus.
- To reach the appendix during operation, follow the taenia coli, which converge toward the appendix.



Vascular, Nerve Supply, and Lymphatic Drainage

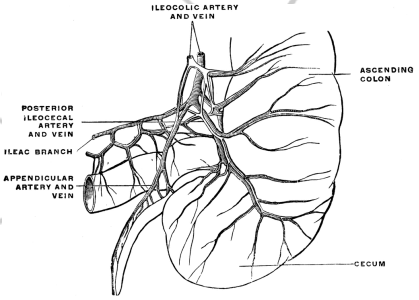
➔ Arterial Supply

- The appendicular artery is a branch of the posterior cecal artery (ileocecal artery), which descends behind the ileum
- The appendicular artery runs in the free margin of the mesoappendix



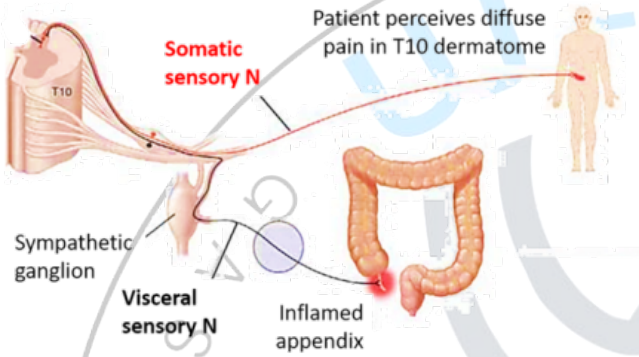
➔ Venous Drainage

- The appendicular vein drains the posterior cecal vein



➔ **Nerve Supply**

- The appendix is supplied by the sympathetic and parasympathetic (Vagus) nerves from the superior mesenteric plexus.
- Afferent nerve fibers concerned with the conduction of visceral pain from the appendix accompany the sympathetic nerves and enter the spinal cord at the level T10.
- The peritoneum over the appendix is innervated by the 10th intercostal nerve = skin of the umbilicus.



➔ **Lymphatic Drainage**

The lymph vessels drain into one or two nodes lying in the mesoappendix ➔ eventually into the superior mesenteric nodes

Clinical Notes

- Acute appendicitis → uncommon in the two extremes of life.
- Pathophysiology:
  - Thrombosis of appendicular artery → gangrene (just one artery for appendix) → perforation → lt. paracolic gutter
  - Contrast this with acute cholecystitis → no gangrene (more than one artery supplies the gallbladder).
- Treatment:
  - Appendectomy.

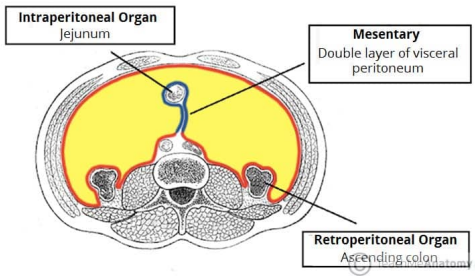
[Ascending Colon]

➔ **General Features**

- The ascending colon is about 5 inches (13 cm) long
- Lies in the right lower quadrant.
- It extends upward from the cecum to the inferior surface of the right lobe of the liver, where it turns to the left, forming the right colic flexure, then becomes continuous with the transverse colon.
- Taenia coli, sacculations & appendeces epiplolca are all present

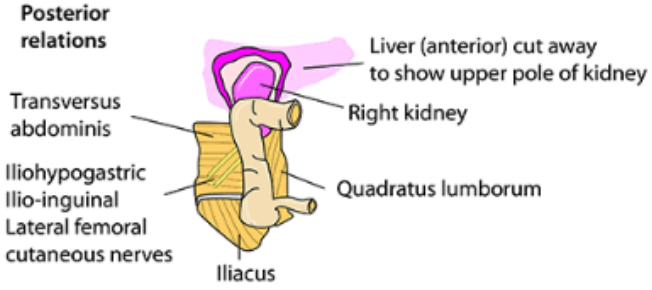
➔ **Peritoneum**

- Covers the front and the sides of the ascending colon
- Bind it to the posterior abdominal wall.



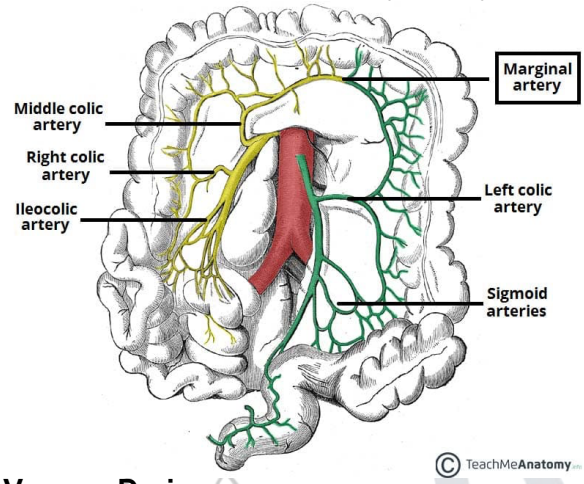
Relations of the Ascending Colon

- **Anteriorly**
  - Coils of the small intestine
  - The greater omentum
  - The anterior abdominal wall
- **Posteriorly**
  - The iliacus
  - The iliac crest
  - The quadratus lumborum
  - The origin of the transversus abdominis muscle
  - The lower pole of the right kidney
  - The iliohypogastric nerve
  - The ilioinguinal nerves

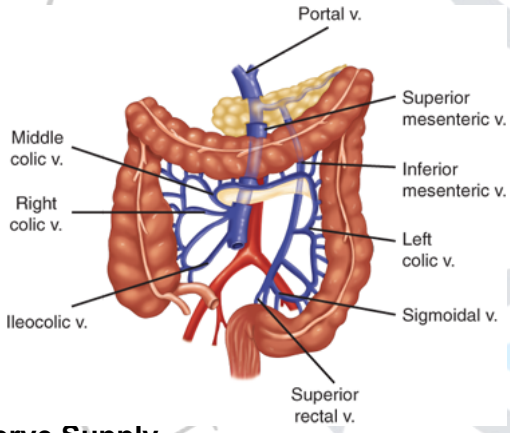


Vascular, Nerve Supply and Lymphatic Drainage

➔ **Arterial Supply**
- The ileocolic & right colic branches of the superior mesenteric artery supply this area.

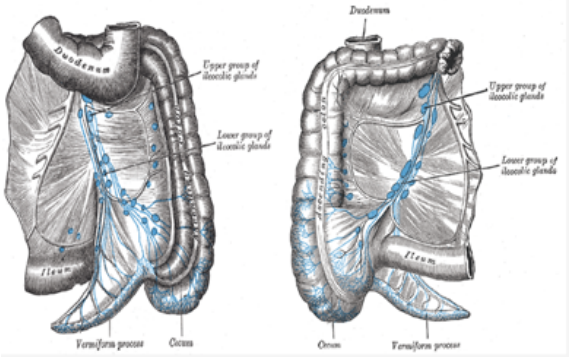


➔ **Venous Drainage**
- The veins correspond to the arteries and drain into the superior mesenteric vein.



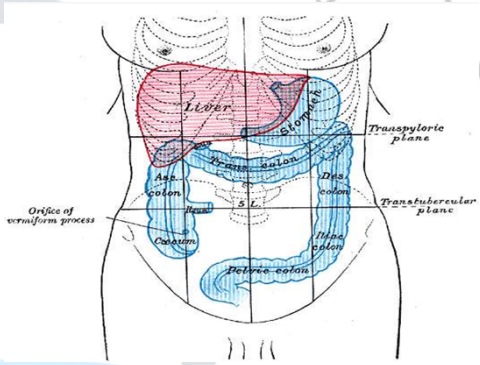
➔ **Nerve Supply**
- Sympathetic and parasympathetic (Vagus) nerves from the superior mesenteric plexus

➔ **Lymphatic Drainage**
- The lymphatic vessels → lymph nodes lying along the course of the colic blood vessels → the superior mesenteric nodes.

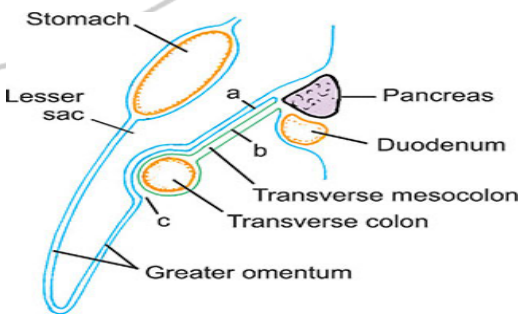


[Transverse Colon]

➔ **General Features**
- The transverse colon is about 15 in. (38 cm) long
- Extends across the abdomen
- Occupies the umbilical region.
- It begins at the right colic flexure below the right lobe of the liver
- Hangs downward
- Suspended by the transverse mesocolon from the pancreas
- It then ascends to the left colic flexure below the spleen.
- The left colic flexure is higher than the right colic flexure and is suspended from the diaphragm by the phrenicocolic ligament
- Taenia coli, sacculations & appendeces epiplolca are present



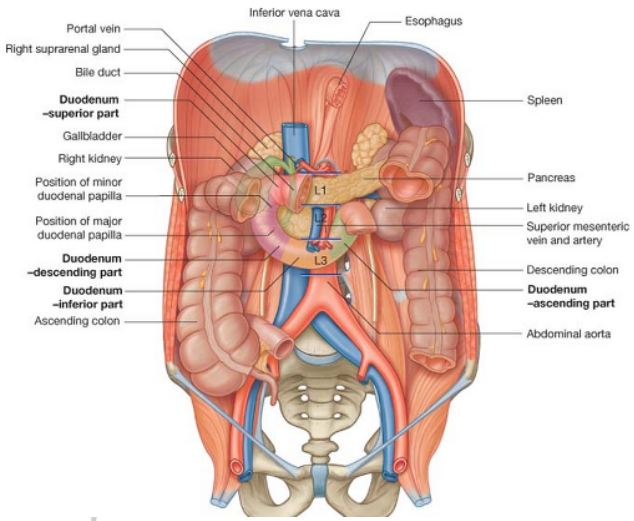
➔ **Peritoneum**
- The transverse mesocolon = mesentery of the transverse colon
- Suspends the transverse colon from the anterior border of the pancreas.
- The mesentery is attached to the superior border of the transverse colon
- The posterior layers of the greater omentum are attached to the inferior border
- The position of the transverse colon is extremely variable and may sometimes reach down as far as the pelvis.



Relations of the Transverse Colon

- **Anteriorly**
  - The greater omentum
  - The anterior abdominal wall (umbilical and hypogastric regions)

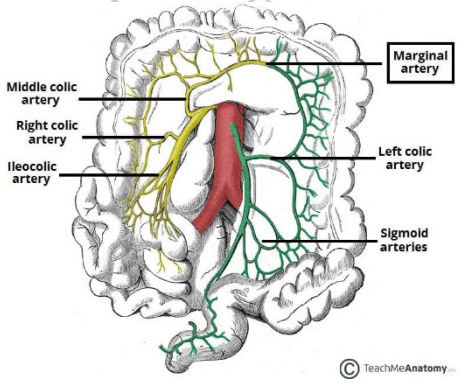
- **Posteriorly**
  - The second part of the duodenum
  - The head of the pancreas
  - The coils of the jejunum and ileum



Vascular, Nerve Supply, and Lymphatic Drainage

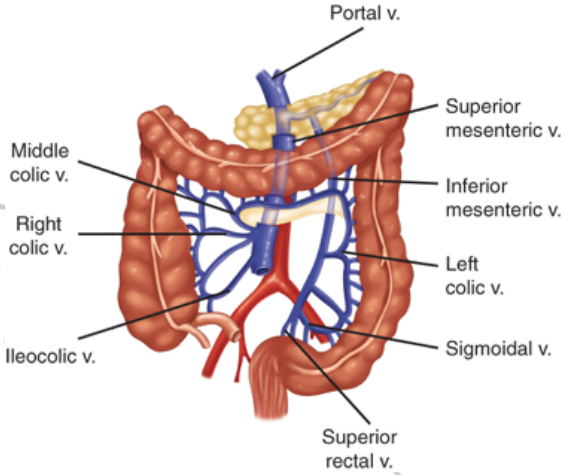
➔ **Arterial Supply**

- The proximal two-thirds are supplied by the middle colic artery → a branch of the superior mesenteric artery
- The **distal third** is supplied by the left colic artery → a branch of the **inferior** mesenteric artery



➔ **Venous Drainage**

- The veins correspond to the arteries and drain into the superior and inferior mesenteric veins.

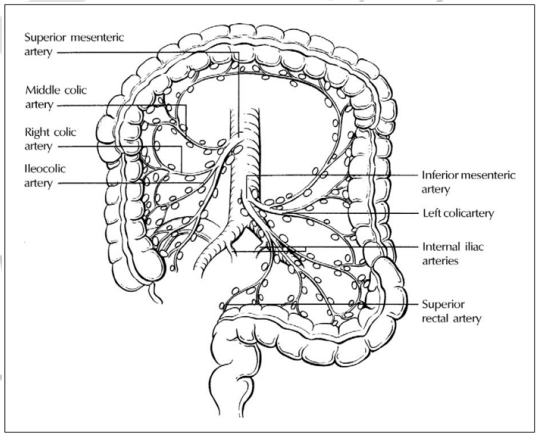


➔ **Nerve Supply**

- The proximal two-thirds are innervated by sympathetic and vagal nerves through the superior mesenteric plexus
- The distal third is innervated by sympathetic and parasympathetic pelvic splanchnic nerves through the inferior mesenteric plexus

➔ **Lymphatic Drainage**

- The proximal two-thirds drain → the colic nodes and then into the superior mesenteric nodes
- The distal third drains → the colic nodes → the inferior mesenteric nodes.



[Descending Colon]

➔ General Features

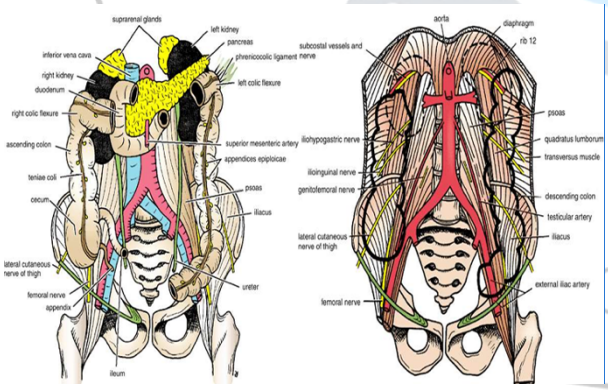
- The descending colon is about 10 in. (25 cm) long
- It extends downward from the left colic flexure to the pelvic brim, where it becomes continuous with the sigmoid colon.
- Taenia coli, sacculation & appendeces epiplolca are present

➔ Peritoneum

- Covers the front and the sides and binds it to the posterior abdominal wall.

Relations of the Descending Colon

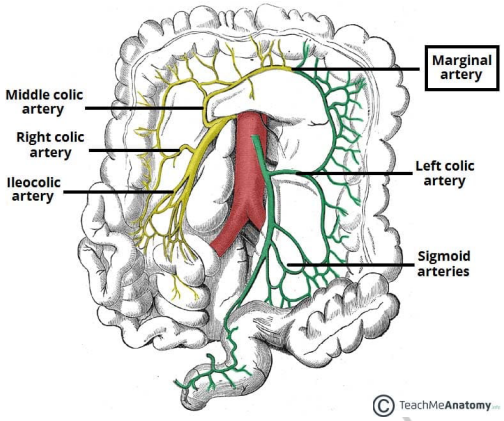
- **Anteriorly**
  - Coils of the small intestine
  - The greater omentum
  - The anterior abdominal wall
- **Posteriorly**
  - The lateral border of the left kidney
  - The origin of the transversus abdominis muscle
  - The quadratus lumborum
  - The iliac crest
  - The iliacus
  - The left psoas
  - The iliohypogastric and the ilioinguinal nerves
  - The lateral cutaneous nerve of the thigh
  - The femoral nerve



Vascular, Nerve supply and Lymphatic Drainage

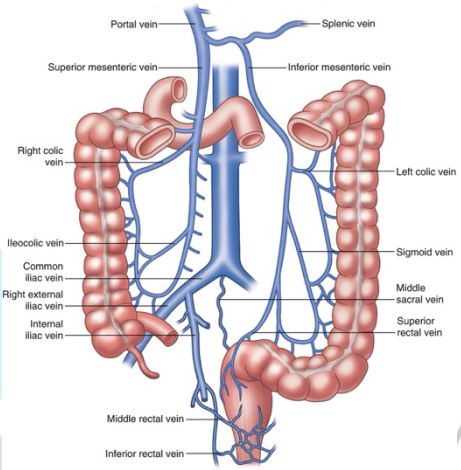
➔ Arterial Supply

- The left colic and the sigmoid branches of the inferior mesenteric artery.



➔ Venous Drainage

- The veins correspond to the arteries → drain into the inferior mesenteric vein.



➔ Nerve Supply

- The nerve supply is the sympathetic and parasympathetic pelvic
- Splanchnic nerves through the inferior mesenteric plexus

➔ Lymphatic Drainage

- Lymphatic drains → the colic lymphatic nodes & the inferior mesenteric nodes around the origin of the inferior mesenteric artery.

The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

Anatomy of the Gallbladder, Spleen and Pancreas

Written by: Reem Abuhamdah

Edited by: Ghada Alzoubi

Reviewed by: Amr Abdallah

[Overview]

➔ Outline of Anatomy of the Gallbladder, Spleen and Pancreas
We will cover:

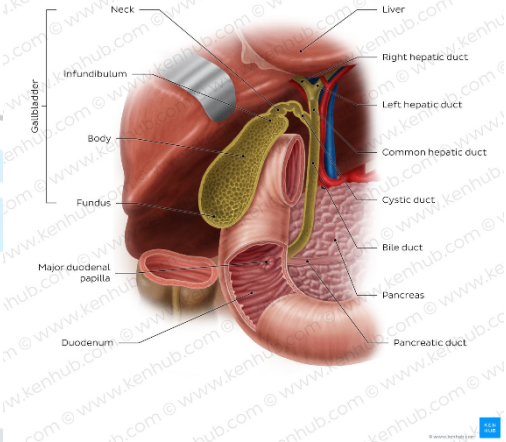
1) **Gallbladder**
   - **➔ Anatomical position of the gallbladder (GB)**
   - **➔ Structure of GB**
   - **➔ Glimpse into histology of the gallbladder**
   - **➔ Blood supply of the GB**
   - **➔ Lymphatic drainage of the GB**
   - **➔ Nerve supply of GB**
   - **➔ Extrahepatic biliary tree**
   - **➔ Common bile duct and its blood supply**
   - **➔ What is bile?**
   - **➔ Gallbladder Diseases**

2) **Pancreas**
   - **➔ Common relations**
   - **➔ Histology of the pancreas**
   - **➔ Parts of the pancreas**
   - **➔ Pancreatic ducts**
   - **➔ Blood supply of the pancreas**
   - **➔ Lymphatic drainage of the pancreas**
   - **➔ Nerve supply of the pancreas**
   - **➔ Congenital defects of the pancreas**
   - **➔ Clinical notes**

3) **Spleen**
   - **➔ Description and Location**
   - **➔ Surfaces of Spleen**
   - **➔ Borders of Spleen**
   - **➔ Blood supply of the spleen**
   - **➔ Lymphatic drainage of the spleen**
   - **➔ Nerve supply of the spleen**

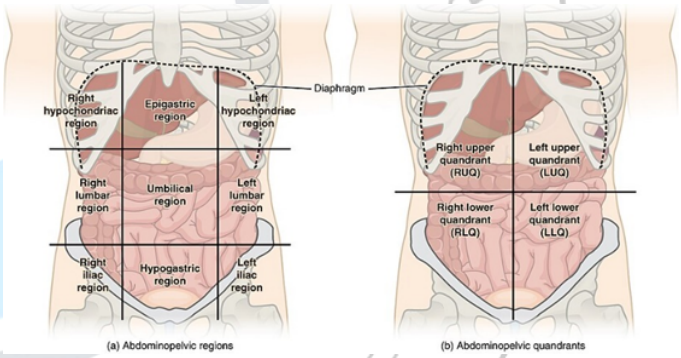
[Gallbladder]

The GB is a green muscular organ, pear shaped, hollow structure, with a capacity of 40-60 cc.

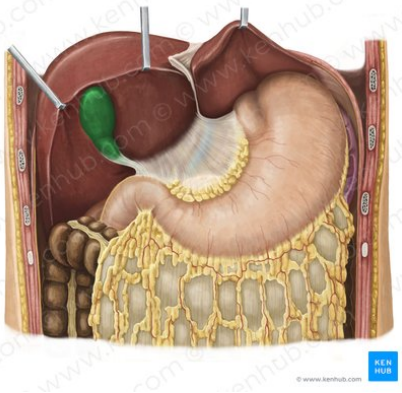


Anatomical position of the gallbladder (GB)

It is found in the epigastric right hypochondrium region, at the tip of the right 9th costal cartilage. (shown below, *count the ribs from inferior, starting at 12)



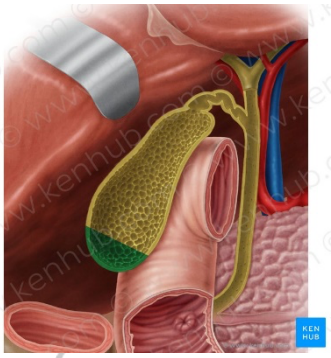
- On the inferior surface of the liver, it lies between the *quadrate* and *right* lobes. (You will get to know these lobes of the liver in the liver lecture; stay tuned).
- It has a short mesentery.

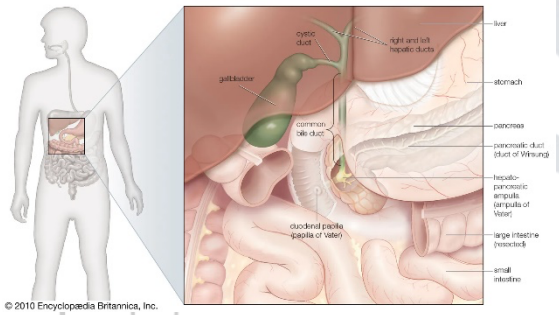


Structure of GB

➔ Fundus

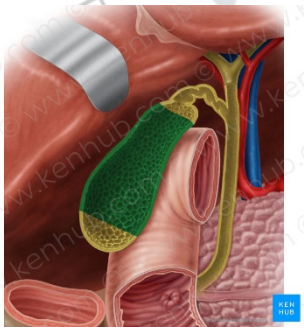
- Anteriorly: anterior abdominal wall
- Posteroinferiorly: transverse colon
- *The first image shows what the fundus is, but poorly shows its relations, so I put another image so you can better imagine it.

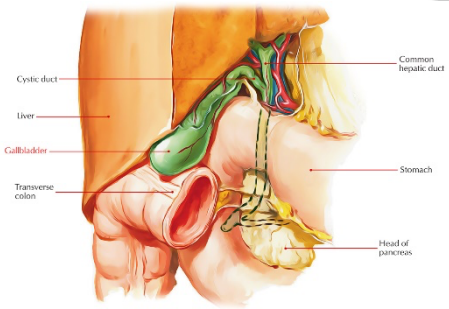




➔ Body

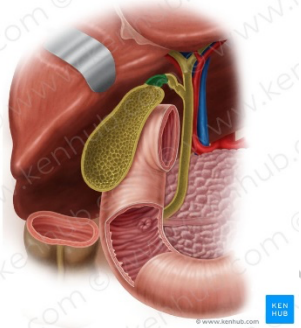
- Superiorly: liver
- Posteroinferiorly: Transverse colon,
- end of 1st part of duodenum, beginning of 2nd part of duodenum. (shown below)

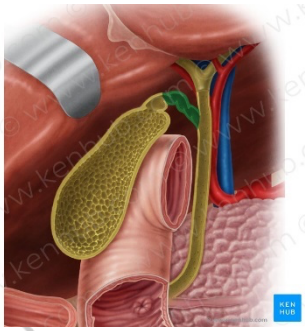




→ Neck

- Forms the cystic duct (4 cm).
- *First image shows the neck, and the second image shows the cystic duct.





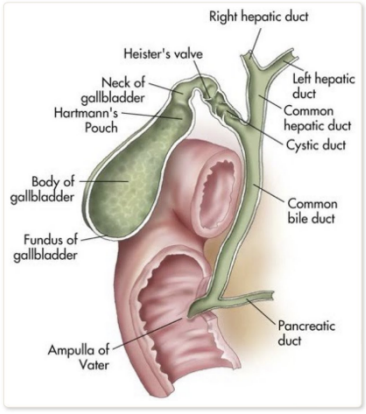
- Body and neck are directed toward the porta hepatis!

*The porta hepatis ("liver gate" in Latin) is the deep fissure on the liver's inferior surface, acting as the main entry/exit point for essential structures.

Hartmann's Pouch

- A small outpouching or depression at the junction of the neck of the gallbladder and the cystic duct.
- Resembles a cupped hand.
- This area promotes stasis of bile, leading to the formation of a single gallstone, which may obstruct the cystic duct. Often requires surgical removal of the gallbladder (cholecystectomy).

*The reason why we are mentioning it is because of its clinical significance in future years; just familiarize yourself with it for now.



Glimpse into histology of the gallbladder:

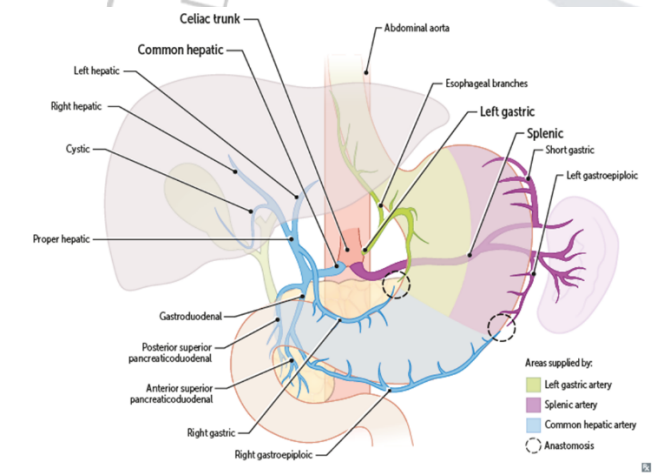
I just want to mention that the gallbladder DOESN'T HAVE A SUBMUCOSA!!!

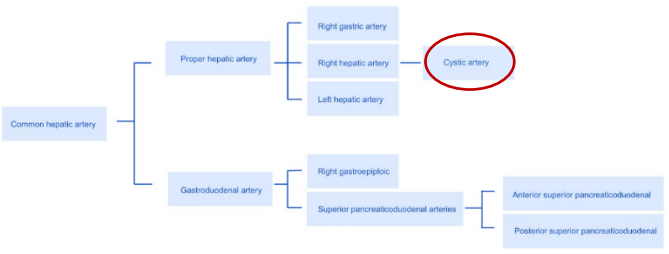
Although a picture in the slides shows the histology of gallbladder stating that there is submucosa, it's very important you know it doesn't.

The reason why it doesn't is because its main function is STORAGE of bile and absorbing the most water it could, it doesn't have to secrete anything!

Blood supply of the GB

Remember this :)
I told you not to skip!





- Cystic artery → branch of the right hepatic artery
- Cystic vein → It empties into the right branch of the portal vein
- Small branches (arteries and veins run between the liver and gall bladder)

Lymphatic drainage of the GB

The gallbladder drains at the *cystic node,* which is located at the neck of GB specifically at the junction of the cystic & common hepatic ducts (we will talk more about these, don't panic, just bear with me), and it's actually a hepatic node!

Other lymph vessels also drain into the hepatic nodes

↓

At the end, lymph drainage terminates at the celiac nodes

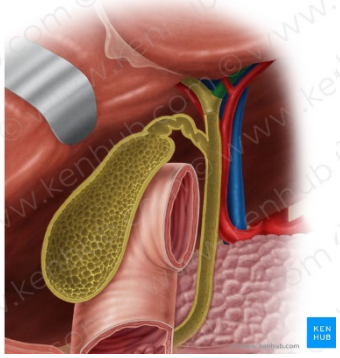
Nerve supply of GB

- Sympathetic → from celiac plexus
- Parasympathetic → Vagus nerve

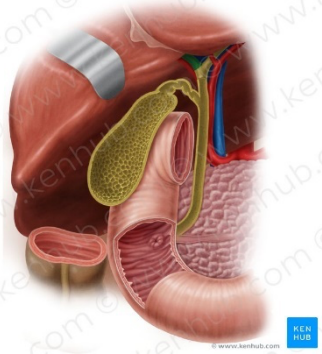
*Hormonal control:
Cholecystokinin is a hormone secreted from the duodenum, and it leads to gallbladder contraction.

Extrahepatic biliary tree

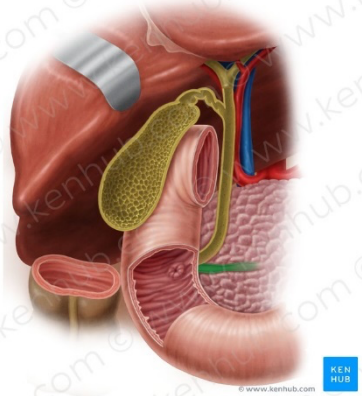
Left hepatic duct



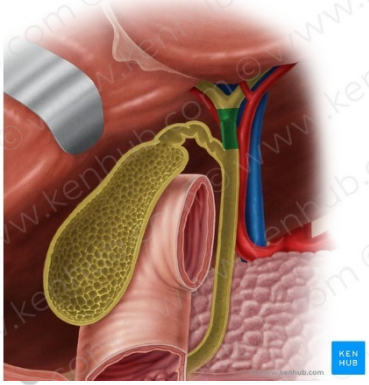
Right hepatic duct



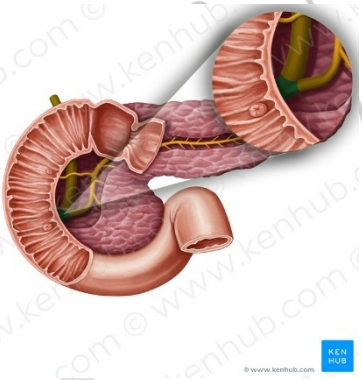
Pancreatic duct



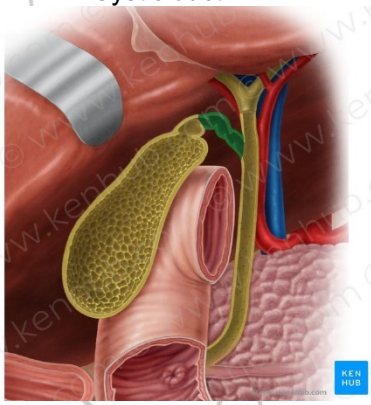
Common hepatic duct



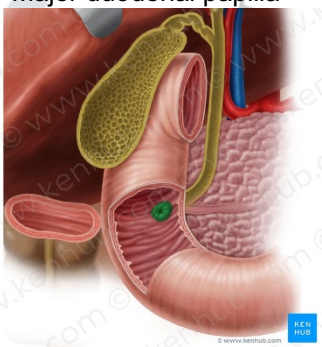
Hepatopancreatic ampulla (ampulla of Vater)



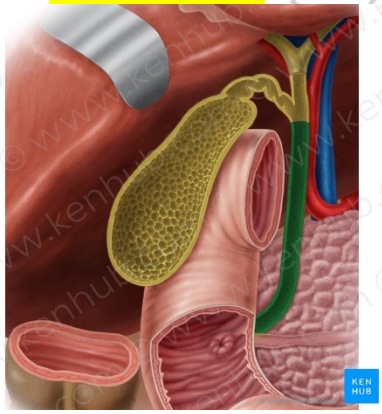
Cystic duct



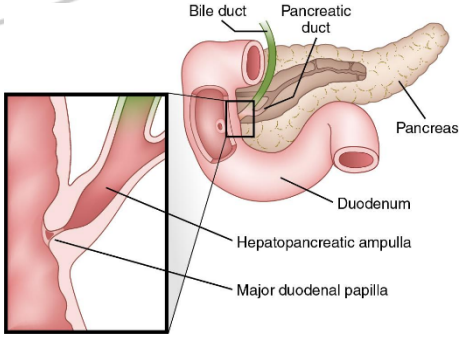
Major duodenal papilla



Common bile duct



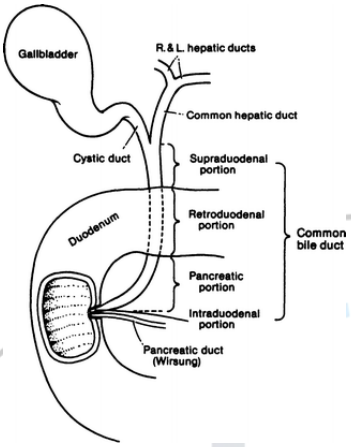
Extra pic to differentiate between the ampulla of Vater and the duodenal papilla



→ **Common bile duct CBD**

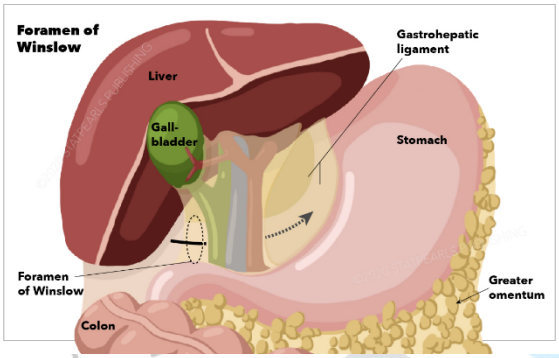
- 10 cm
- Descends in the free edge of the lesser omentum, and has 3 parts:

1. Supraduodenal part
2. Retroduodenal part
3. Retropancreatic part



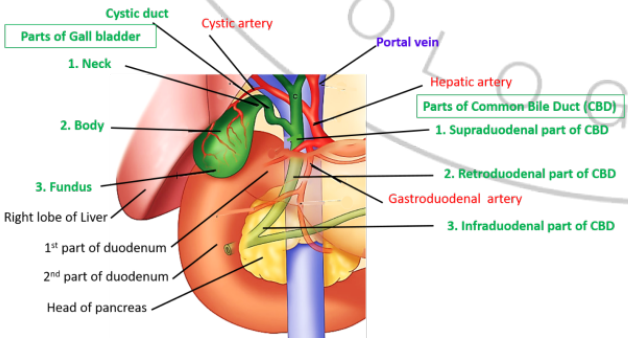
→ 1st part (supraduodenal)

- Located in the right free margin of the lesser omentum, in front of the opening into the lesser sac (Epiploic opening)
- Right to hepatic artery and portal vein



→ 2nd part (retroduodenal part)

- Behind the 1st part of the duodenum
- Right to the gastroduodenal artery



→ 3rd part (retropancreatic)

- Posterior surface of the head of the pancreas
- Contact with the main pancreatic duct
- Related to the IVC, gastroduodenal artery, portal vein
- Ends in the half-second part of the duodenum at the ampulla of Vater.

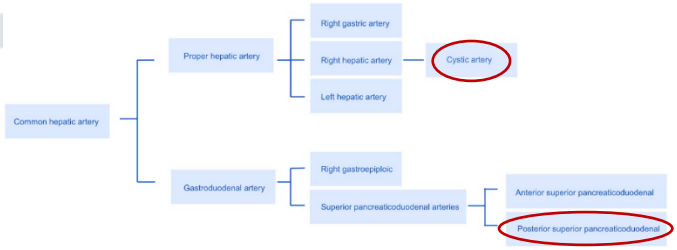
(see previous image)

Blood supply of CBD

Small arteries supplying the CBD

a. Arise from the cystic artery

b. Posterior branch of the superior pancreaticoduodenal artery



What is bile?

- Bile is composed of water, ions, bile acids, and organic molecules (including cholesterol, phospholipids, and bilirubin).
- It is made in the liver and stored in the GB.
- Bile functions:
  1. Bile acids and salts function to emulsify fats for absorption across the wall of the small intestines into lacteal lymph capillaries.
  2. Contains waste products from RBC breakdown and other metabolic processing (color of feces from bilirubin in bile).
  3. Buffers acidic chyme entering the duodenum from the stomach.
- There are multiple types of gallstones; the most common type is cholesterol gallstones.

Gallbladder Diseases

***Each point reflects a major topic you will learn later on, Inshallah, just familiarize yourself with the terms.**

1- Cholelithiasis & Cholecystitis
Cholecystitis = inflammation of GB
Cholelithiasis = Stone(s) in GB

So cholelithiasis could lead to cholecystitis!

2- Obstructive jaundice: liver patterns

*Here, the doctor is referring to the liver function test LFT). We mainly have two patterns: hepatocellular and cholestatic (obstructive pattern). Certain labs get elevated in each, and are characteristic of each. I thought I'd mention it if anyone is curious; no need to know this now.

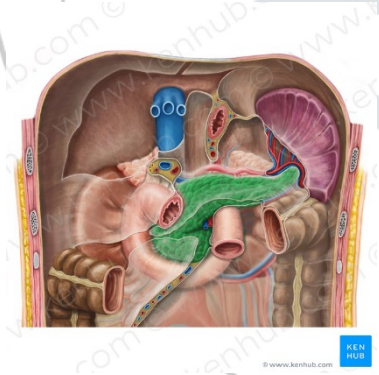
Choledocholithiasis = Stone in CBD
Stone in C.B.D can lead to obstruction, and patients can present with jaundice or pancreatitis…

So choledocholithiasis could lead to obstructive jaundice!

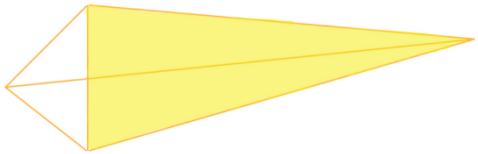
3- Gangrene of the gall bladder is rare

4- Congenital defects

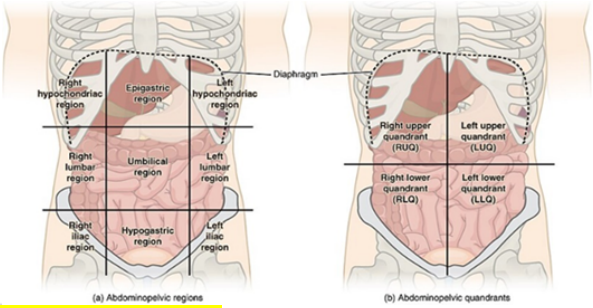
[Pancreas]



- Anatomical position



Epigastric, left upper hypochondrium region.



Common relations

→ Anterior
- -Transverse colon
- -Transverse mesocolon
- -Lesser sac
- -Stomach

→ Posterior
- -Bile duct
- -Portal vein
- -Splenic vein
- -IVC
- -Aorta
- origin of the superior mesenteric artery
- -Left Psoas muscle
- -Left Suprarenal gland
- -Left kidney
- -Hilum of the spleen

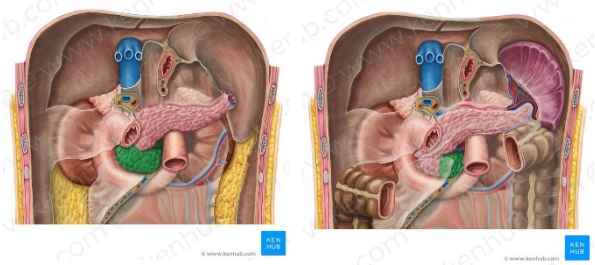
Histology of pancreas

Exocrine part→ secretes pancreatic juice

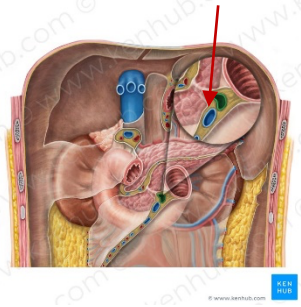
Endocrine part → secretes insulin, glucagon and somatostatin

Parts of the Pancreas

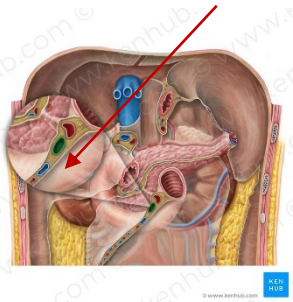
➔ Head
- -It is disc-shaped
- lies within the concavity of the duodenum
- A part of the head extends to the left
- behind the superior mesenteric vessels (vessels shown below) and is called the Uncinate process (shown in the second pic).



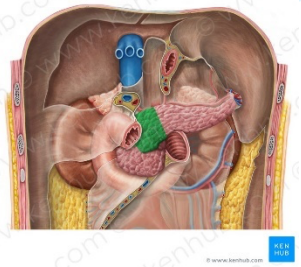
superior mesenteric artery



superior mesenteric vein

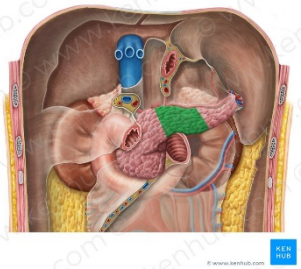


➔ **The neck**



- It is the constricted portion of the pancreas
- It connects the head to the body.
- It lies in front of the beginning of the portal vein.

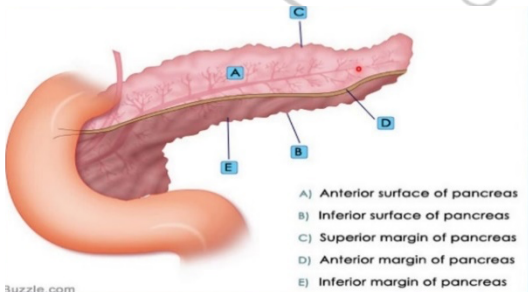
➔ **The body**



- -Runs upward
- and to the left
- across the
- midline
- It is somewhat
- triangular in
- cross-section.

*You need a big imagination for the next part, I couldn't find enough images, unfortunately, so I tried to draw some images to make memorizing easier.

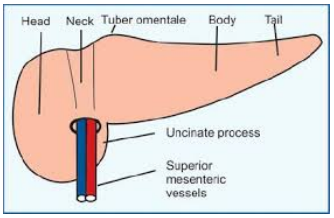
- The body has 3 surfaces: **anterior, posterior,** and **inferior.**



[The anterior surface]

- Covered by the *peritoneum of the posterior wall of*
- *lesser sac.*

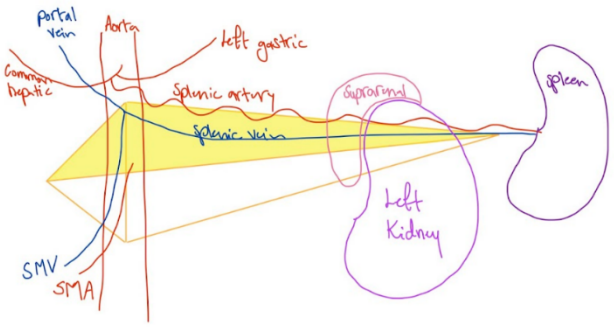
-Tuber omental*:* where the anterior surface of the pancreas joins the neck.



[The posterior surface]

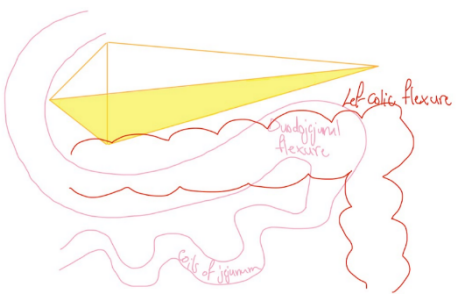
- devoid of peritoneum
- in contact with:

1- the aorta
2- the splenic vein
3- the left kidney and its vessels
4- the left suprarenal gland
5- The origin of the superior mesenteric artery
6- and the crura of the diaphragm.



[The inferior surface]

- Narrow on the right but broader on the left
- Covered *by the peritoneum of the greater omentum*
- lies upon the duodenojejunal flexure
- Some coils of the jejunum
- Its left extremity rests on the left colic flexure.

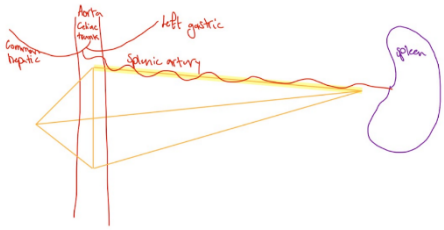


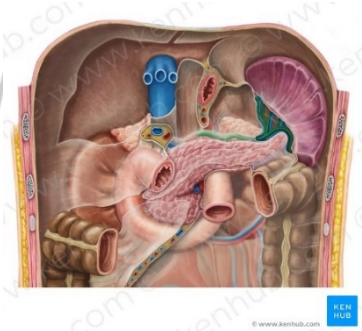
- -The body also has 3 borders**: anterior, posterior (same as superior) & inferior.**

- [The **posterior/ superior border]**
- Blunt and flat to the right;
- Narrow and sharp to the left near the tail
- It commences on the right in the omental tuberosity
- In relation to

1- The celiac artery
2- Hepatic artery
3- *The splenic artery runs toward the left in a groove along this border, shown in green on the next page.* (high yield)

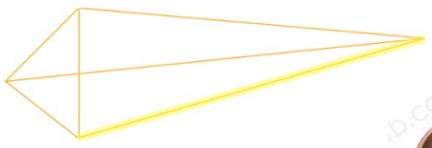
***The splenic artery is one of three vessels that are tortuous in the body!**

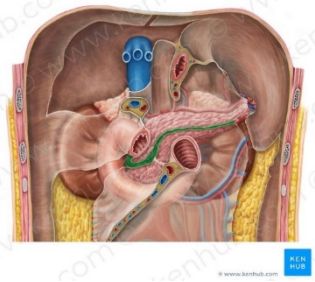




[The **anterior border]**

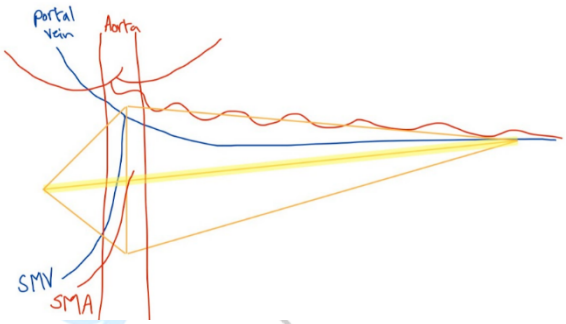
- separates the anterior surface from the inferior surface
- along this border, the two layers of the transverse mesocolon (shown in green) diverges from one another; one passes upward over the anterior surface, the other backward over the inferior surface.

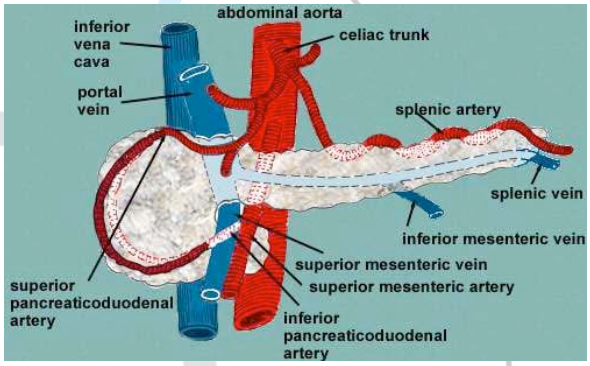




[The inferior border]

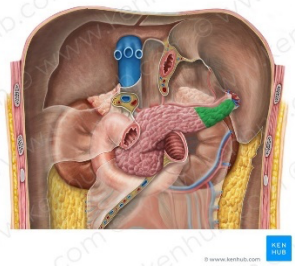
- -separates the posterior from the inferior surface
- The superior mesenteric vessels emerge under its right extremity.





➔ The Tail

- Passes forward in the splenorenal ligament and comes in contact with the hilum of the spleen



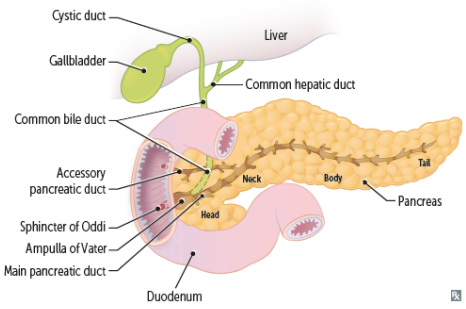
Pancreatic ducts

→ The main duct

- Begins in the tail and runs the length of
  - the gland, receiving numerous tributaries on the way.
  - It opens into the second part of the
  - duodenum at about its middle *with the bile duct* on the major duodenal papilla.

→ Accessory duct

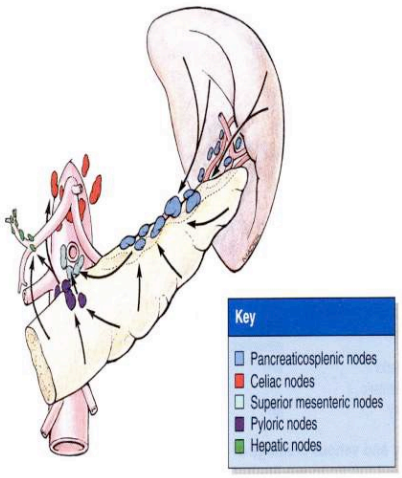
- When present, it drains the upper part of the Head.
  - Then opens into the duodenum a short
  - distance above the main duct on the minor
  - duodenal papilla.
    - The accessory duct frequently communicates with the main duct.



This image again :)

Lymphatic drainage of the pancreas

• Lymph nodes are situated along the arteries that supply the gland.
• The efferent vessels ultimately drain into the celiac and superior mesenteric lymph nodes.



Blood Supply of the Pancreas

➔ Arteries

• The splenic artery
• The superior pancreaticoduodenal artery (we studied this before)
• Inferior pancreaticoduodenal arteries (directly from SMA).

➔ Veins

• The corresponding veins drain into the **portal system.**

Nerve supply

• Sympathetic and parasympathetic chain
• Parasympathetic = vagus nerve

Congenital defects of the pancreas

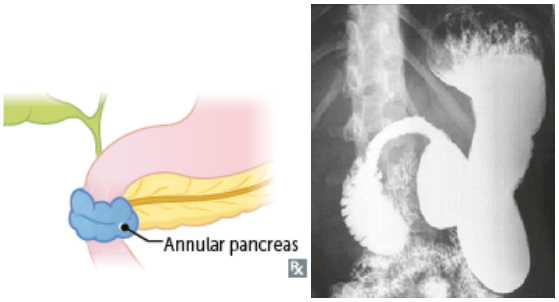
- Annular Pancreas: pancreas encircles Duodenum. (rare)
- Ectopic Pancreas: Outside the gastrointestinal tract. (very common)

Step one content (skip if not interested)

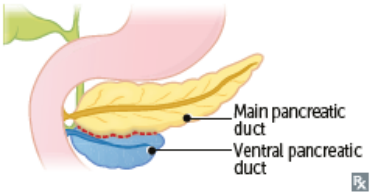
- Pancreas—derived from foregut. Ventral pancreatic bud contributes to uncinate process.

- Both ventral and dorsal buds contribute to pancreatic head and main pancreatic duct.

- Annular pancreas—abnormal rotation of ventral pancreatic bud forms a ring of pancreatic tissue
- encircles 2nd part of duodenum; may cause duodenal narrowing (shown below) and vomiting.
- Associated with Down syndrome.



- Pancreas divisum—ventral and dorsal parts fail to fuse at 7 weeks of development. Common anomaly; mostly asymptomatic, but may cause chronic abdominal pain and/or pancreatitis



Clinical notes

Again, just familiarize yourself with the terms.

• Cancer of the head of the pancreas → Obstructive jaundice
• Cancer body of pancreas → pressure on I.V.C & portal vein
*That's why, when pancreatic cancer is in the tail, patients present in late stages because symptoms are vague.

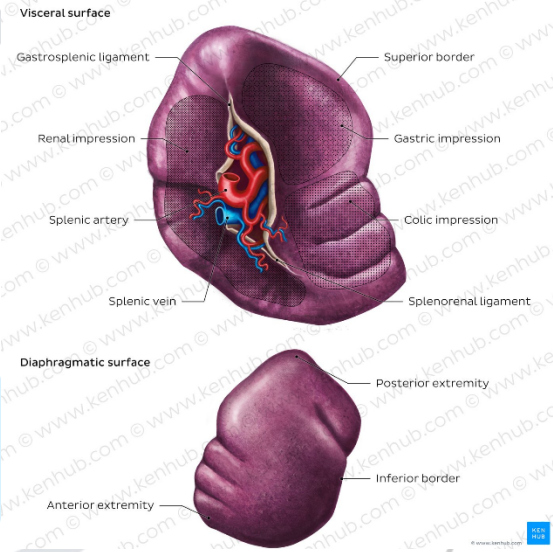
• Acute pancreatitis = inflammation of pancreas

[Spleen]

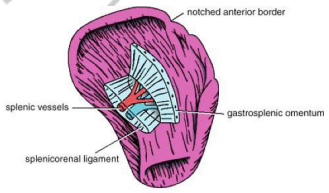
Description and Location

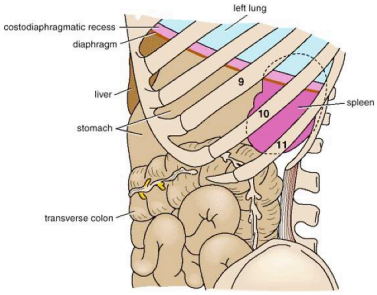
Description

- it is reddish & oval in shape
- It is the largest single mass of lymphoid tissue in the body, and has a notched anterior border.



Location

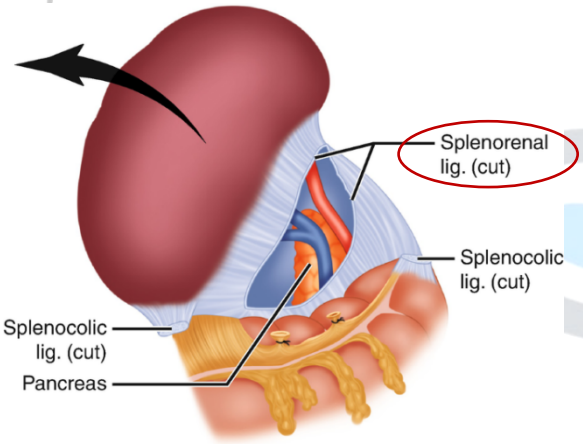




- Left hypochondrium
- It lies just beneath the left half of the diaphragm under the **9th, 10th, and 11th** ribs. (high yield)
- Its long axis is parallel to the 10th rib
- The medial end is 4 cm away from the midline.
- Lateral end is in the left mid-axillary line.

Peritoneum
• The spleen is completely covered with peritoneum; it is an intraperitoneal organ
• Two ligaments
1- the gastrosplenic omentum (ligament): between the spleen & the greater curvature of the stomach (carrying the short gastric and left gastroepiploic vessels).

2- Splenorenal ligament: between the spleen & kidney (carrying the splenic vessels and the tail of the pancreas).



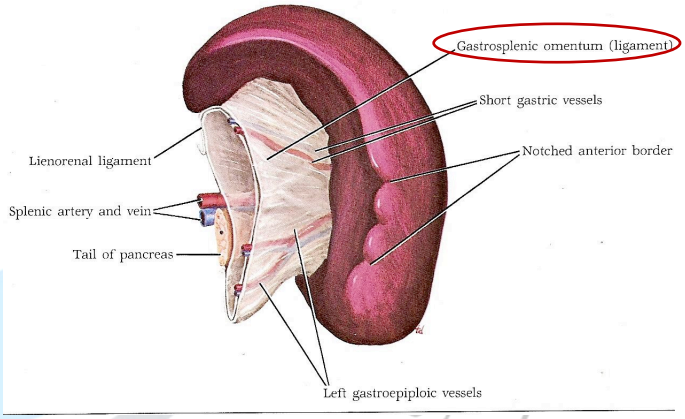
The 1 3 5 7 9 11 rule
Size
1 inch thick
3-inch broad
5 inches long
Weight
7 ounces
Location
Under the **9-11th** ribs
Shape → variable
2 ends
2 borders
2 surfaces
Notched→ Due to lobulation in the embryo

Surfaces of the spleen

2 surfaces → **Diaphragmatic surface**, **Visceral surface**

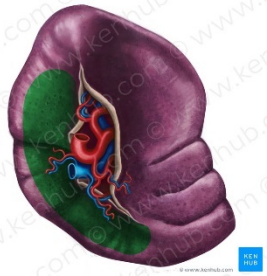
1- Diaphragmatic surface
- Has a posterolateral relation
- Convex
- Smooth
- Diaphragm separates it from Pleura & lung and 9th 10th 11th left ribs.

2- Visceral surface
- Has anteromedial relations
- It is divided by a ridge into:



1- An anterior or gastric portion.
- Extends forward, upward, and medialward
- Broad and concave
- Related to the stomach

2- A posterior or renal portion.
- Directed medially and
- downward.
- It is somewhat flattened
- Related to left kidney



The lower extremity has
• Colic surface (shown in pic below) and pancreatic surface (not shown).

The **lower extremity** or **colic surface**

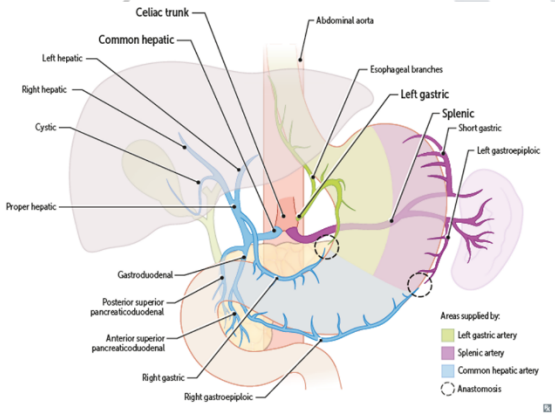
- It is flat
- Triangular in shape
- Rests upon the left flexure of the colon and the phrenicocolic ligament, and is generally in

contact with the tail of the pancreas (pancreatic surface).

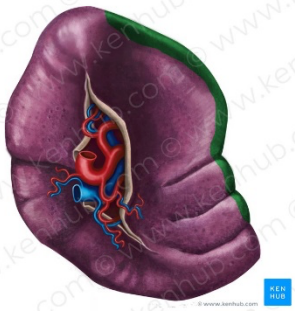
• Hilum of spleen

- Splenic artery anteriorly.
- Splenic vein posteriorly.
- Tail of pancreas

Borders of the spleen

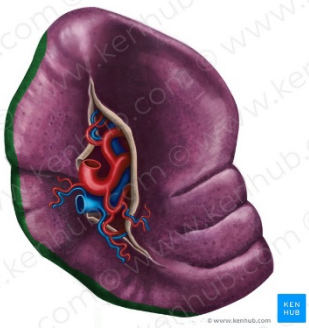


1- Superior Border



- It is free
- Sharp
- Thin
- Often notched (superior notch), especially below
- It separates the diaphragmatic surface from the gastric surface.

2- Inferior border

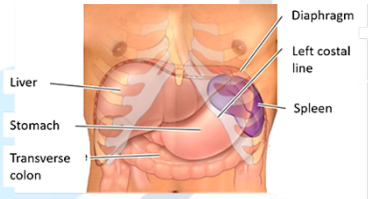


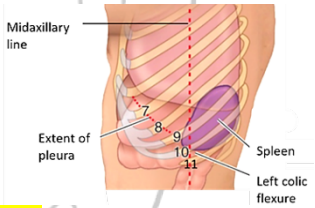
- More rounded and blunter
- Separates the diaphragmatic surface from the renal surface.
- It corresponds to the lower border of
- the eleventh rib.
- lies between the diaphragm and the left kidney.

The intermediate margin: is the ridge which separates the renal and gastric surfaces.
Internal border: separates the diaphragmatic from the colic surface.
(couldn't find images).

2 Ends

• Medial end→ superior & back, 4cm away from midline posteriorly
• Lateral end→ in the left mid axillary line

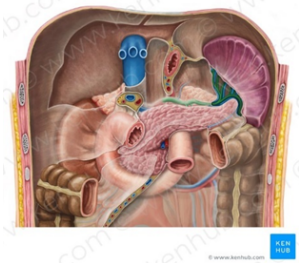




Blood supply of the Spleen

Artery

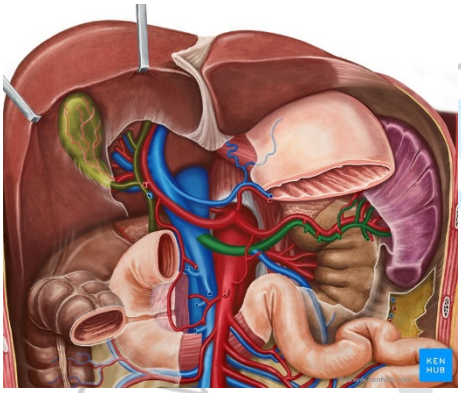
• The large splenic artery is the **largest branch** of the celiac artery.
• It has a tortuous course
• It runs along the upper border of the pancreas
• The splenic artery then divides into about six branches, which enter the spleen at the hilum.



Veins

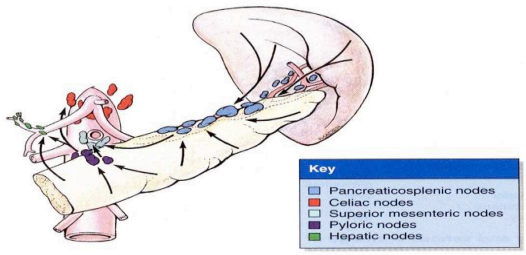
- The splenic vein leaves the hilum and runs
- behind the tail and the body of the pancreas.
- Behind the neck of the pancreas, the splenic

vein joins the superior mesenteric vein to form the portal vein. (high yield)



Lymphatic Drainage of the Spleen

• The lymph vessels emerge from the hilum and pass through a few lymph nodes along the course of the splenic artery and then drain into the celiac nodes.



Nerve Supply of the Spleen

• The nerves accompany the splenic artery and are derived from the celiac plexus.

The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

The Posterior Abdominal Wall

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Edited by: Bdour Abdallat
Reviewed by: Amr Abdallah

[Overview]

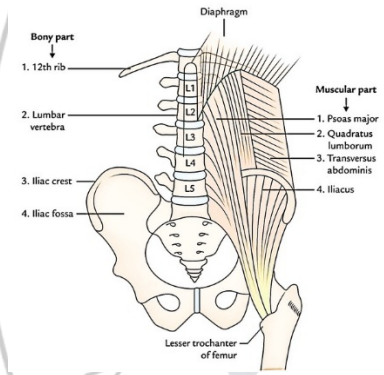
➔ **Outline of The Posterior Abdominal Wall:**

1) Posterior Abdominal Wall
2) Arteries of the Posterior Abdominal Wall
3) Veins of the Posterior Abdominal Wall
4) Portal Systemic Anastomosis
5) Lymphatics of the Posterior Abdominal Wall

[The Posterior Abdominal Wall]

➔ **Structures of the Posterior Abdominal Wall:**

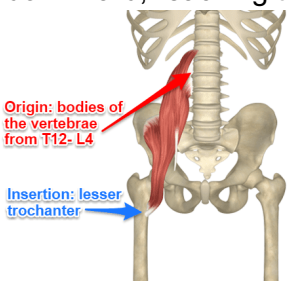
- 5 lumbar vertebra & their intervertebral disc
- 12th ribs
- Upper part of the bony pelvis
- Muscles
  - Psoas Major
  - Psoas Minor
  - Quadratus Lumborum
- Aponeurosis of the transversus abdominis muscles
- The Iliacus muscle lies in the iliac fossa



[Muscles of the Posterior Abdominal Wall]

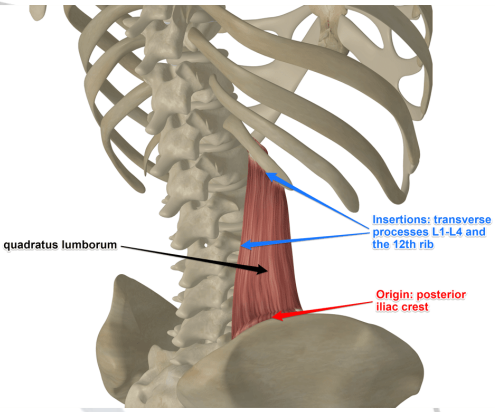
Psoas Major

- Origin:
- Body and transverse process of the lumbar vertebra and the intervertebral disc
- Insertion:
- Lesser trochanter of the femur
- Nerve Supply:
- Nerve plexus - T12, L1, L2, L3
- Action:
- Flexion of the hip and thigh
- This muscle is prone to abscesses that can "track downward, reaching the pelvis



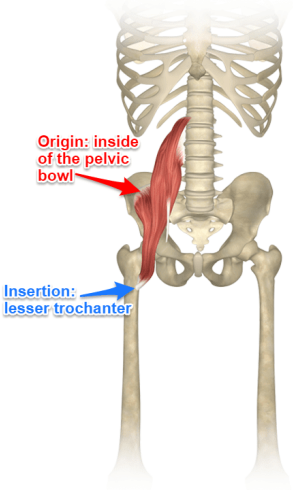
Quadratus Lumborum

- Origin:
- Iliolumbar ligament and iliac crest
- Insertion:
  - 12^{th} rib
- Nerve Supply:
  - Nerve Plexus - T12, L1, L2, L3
- Action:
- Fixes or depresses the 12^{th} rib during respiration and lateral flexion of the trunk



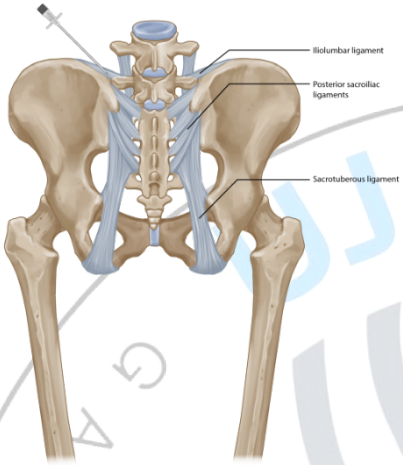
Iliacus Muscle

- Origin:
- Iliac fossa
- Insertion:
  - Lesser trochanter of the femur
- Nerve Supply:
  - Femoral nerve
- Action:
- Lateral flexion of the hip and thigh for walking and sitting upright



The Iliolumbar Ligament

- The iliolumbar ligament is a strong ligament passing from the tip of the transverse process of the 5th lumbar vertebra to the posterior third of the inner lip of the iliac crest

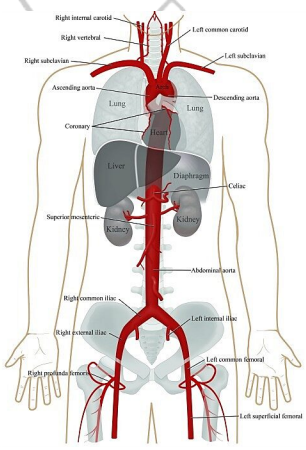


[Arteries of the Posterior Abdominal Wall]

Aorta

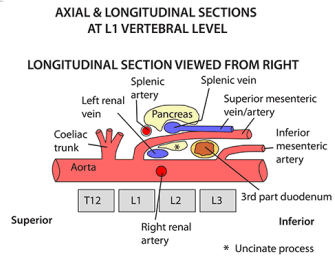
- Location & description

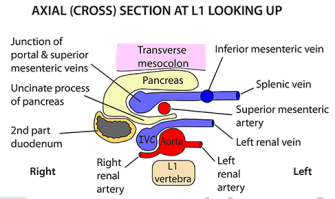
- The aorta enters the abdomen through the aortic opening of the diaphragm in front of the 12th thoracic vertebra.
- It descends behind the peritoneum on the anterior surface of the bodies of the lumbar vertebrae.
- It ends at the level of the 4th lumbar vertebra at the left side by bifurcating into two common iliac arteries.



- Relations

- **Anteriorly:**
  - Pancreas
  - 3rd part of the duodenum
  - Coils of the small intestine
  - Crossed by lt. renal vein
- **On its right:**
  - Inferior vena cava
  - Cisterna chyli
  - Beginning of the azygos vein.
- **On its left:**
  - Left sympathetic trunk.





- Overview of the branches of the abdominal aorta

- **Single branches:**
  - 3 anteriorly & 1 posteriorly
- **Anterior:**
  - Celiac trunk
  - Superior mesenteric artery
  - Inferior mesenteric artery
- **Posterior:**
  - Median sacral artery
- **Paired branches:**
  - 1 ant. → testicular or ovarian artery at level L2
  - 4 post. → lumbar arteries
  - 3 laterally →
    - Inferior phrenic a.
    - Middle suprarenal a.
    - Renal a.

Branches of the Abdominal Aorta

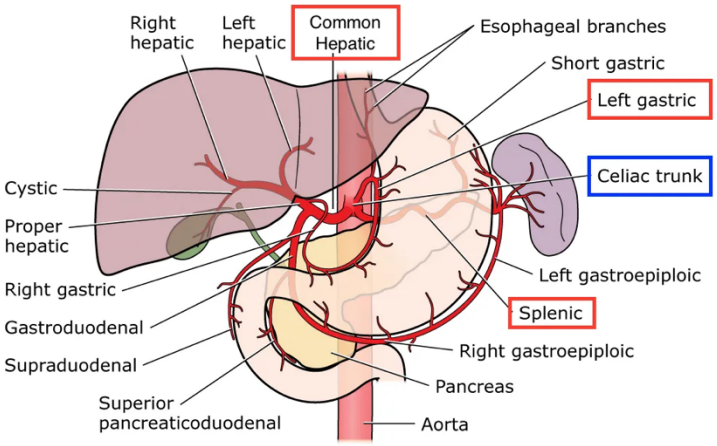
Celiac Artery - at L1

- The celiac artery or trunk is very short(~1 cm) and arises from the commencement of the abdominal aorta at the level of the 12th thoracic vertebra. It is surrounded by the celiac plexus and lies behind the lesser sac of peritoneum. It provides the main arterial supply to the foregut.
- It has three terminal branches:

1. Left gastric
    - The small left gastric artery runs to the cardiac end of the stomach, gives off a few esophageal branches, then turns to the right along the lesser curvature of the stomach.
    - It anastomoses with the **right** gastric artery

2. Splenic artery
    - Pancreatic branches
    - Left gastroepiploic artery
    - Short gastric arteries → fundus

3. Hepatic arteries
    - The right gastric artery arises from the hepatic artery at the upper border of the pylorus and runs to anastamose with the left in the lesser omentum along the lesser curvature of the stomach.
    - The gastroduodenal artery → divides into the right gastroepiploic artery that runs along the greater curvature of the stomach between the layers of the greater omentum and the superior pancreaticoduodenal artery that descends between the second part of the duodenum and the head of the pancreas.
    - The right and left hepatic arteries enter the porta hepatis.
    - The right hepatic artery usually gives off the cystic artery, which runs to the neck of the gallbladder (HY!)

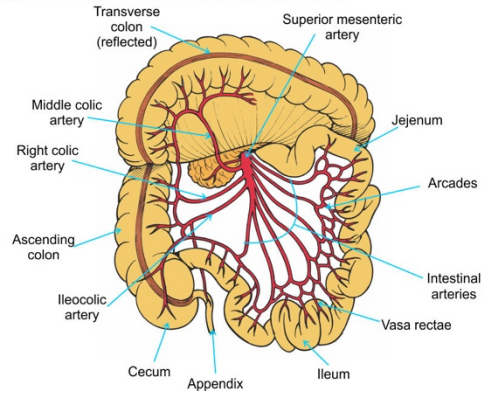


Superior Mesenteric Artery - at L2

The SMA provides the main arterial supply to the midgut. Its main branches include:

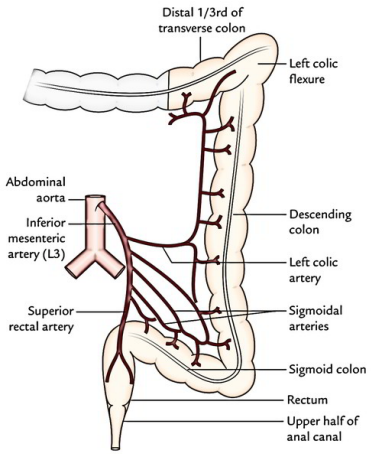
- The inferior pancreaticoduodenal artery.
- The middle colic artery runs forward in the transverse mesocolon to supply the transverse colon and divides into right and left branches.
- The right colic artery is often a branch of the ileocolic artery. It passes to the right to supply the ascending colon and divides into ascending and descending branches.
- The ileocolic artery passes downward and to the right. It gives rise to a superior branch that anastomoses with the right colic artery and an inferior branch that anastomoses with the end of the superior mesenteric artery. The inferior branch gives rise to the anterior and posterior cecal arteries; the appendicular artery is a branch of the posterior cecal artery.
- The jejunal and ileal branches are 12 to 15 in number and arise from the left side of the superior mesenteric artery . Each artery divides into two vessels, which unite with adjacent branches to form a series of arcades.
- Branches from the arcades divide and unite to form a second, third, and fourth series of arcades.
- Fewer arcades supply the jejunum than supply the ileum.
- From the terminal arcades, small straight vessels supply the intestine

Figure339 - Superior mesenteric artery and branches



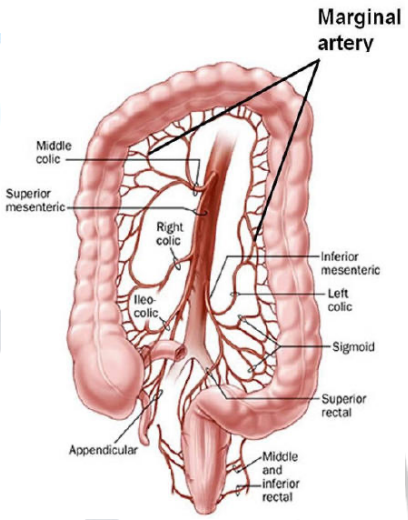
Inferior Mesenteric Artery - at L3 Branches

- The left colic artery runs upward and to the left and supplies the distal third of the transverse colon, the left colic flexure, and the upper part of the descending colon. It divides into ascending and descending branches.
- The sigmoid arteries are two or three in number and supply the descending and sigmoid colon.
- The superior rectal artery is a continuation of the inferior mesenteric artery as it crosses the left common iliac artery. It descends into the pelvis behind the rectum. The artery supplies the rectum and upper half of the anal canal and anastomoses with the middle rectal and inferior rectal arteries.



Marginal Artery

- The anastomosis of the colic arteries around the concave margin of the large intestine forms a single arterial trunk called the marginal artery.
- This begins at the ileocecal junction, where it anastomoses with the lleal branches of the superior mesenteric artery, and it ends where it anastomoses less freely with the superior rectal artery

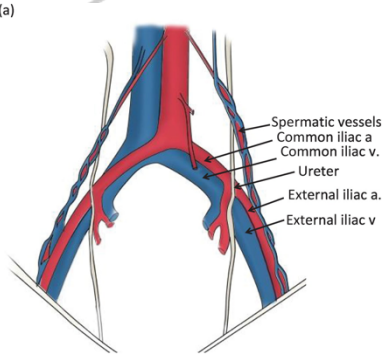


Terminal Branches of the Aorta

Common Iliac Arteries

- The right and left common iliac arteries are the terminal branches of the abdominal aorta.
- They arise at the level of the 4th lumbar vertebra and run downward and laterally along
- At medial border of the psoas muscle.
- Each artery ends in front of the sacroiliac joint by dividing into the external and internal iliac arteries.
- At the bifurcation, the common iliac artery on each side is crossed anteriorly by the ureter.

(a)



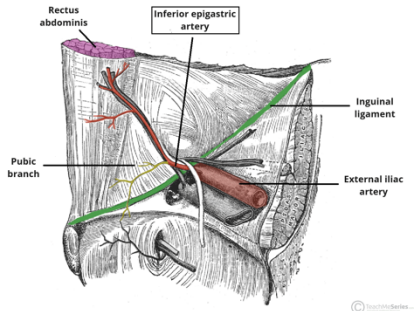
Branches of the Common Iliac Arteries

1. External Iliac Artery

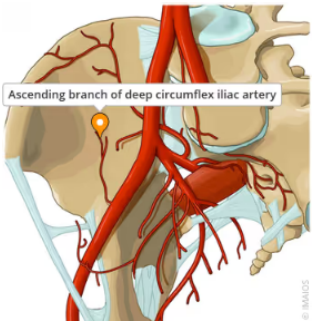
- Runs along the medial border of the Psoas, following the pelvic brim.
- It gives off the Inferior Epigastric and Deep Circumflex Iliac branches.
- The artery enters the thigh by passing under the inguinal ligament to become the Femoral Artery.

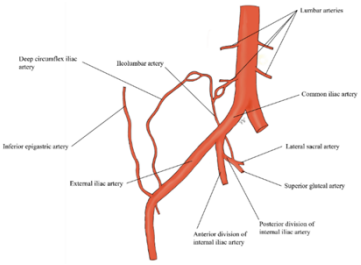
Branches of the external iliac artery

- **The inferior epigastric**
  - Artery arises just above the inguinal ligament.
  - It passes upward and medially along the medial margin of the deep inguinal ring and enters the rectus sheath behind the rectus abdominis muscle.



- **The deep circumflex iliac**
  - Artery arises close to the Inferior Epigastric Artery.
  - It ascends laterally to the anterior superior iliac spine and the iliac crest, supplying the muscles of the anterior abdominal wall.





2. Internal Iliac Artery

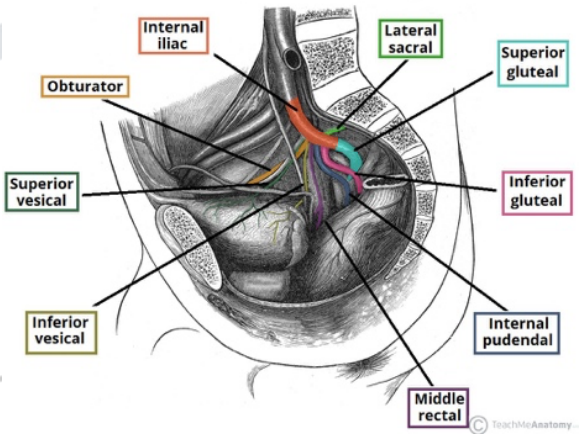
- The internal iliac artery passes down into the pelvis in front of the sacroiliac joint

Posterior

- Iliolumbar artery
- Lateral sacral arteries
- Superior gluteal artery - greater sciatic foramen

Anterior

- Obturator artery (occasionally from inferior epigastric artery) - obturator canal
- Inferior gluteal artery - greater sciatic foramen
- Umbilical artery, superior vesical artery (usually, but sometimes it branches directly from the anterior trunk), medial umbilical ligament
- Uterine artery (females) or deferential artery (males), superior and vaginal branches of the uterus, vas deferens
- Vaginal artery (females, can also arise from the uterine artery) – vagina
- Inferior vesical artery - urinary bladder
- Middle rectal artery – rectum
- Internal pudendal artery

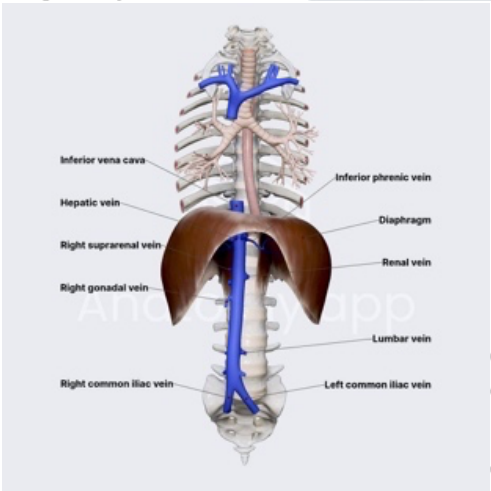


[Veins of the Posterior Abdominal Wall]

Inferior Vena Cava

Location and Description:

- The inferior vena cava conveys most of the blood from the body below the diaphragm to the right atrium of the heart.
- It is formed by the union of the common iliac veins behind the right common iliac artery at the level of the **fifth** lumbar vertebra
- It ascends on the right side of the aorta, pierces the central tendon of the diaphragm
- It ascends then separated from the aorta by the right crus of the diaphragm
- Ends at the level of the **eighth** thoracic vertebra, and drains into the right atrium of the heart.
- The right sympathetic trunk lies behind its right margin, and the right ureter lies close to its right border. The entrance into the lesser sac separates the inferior vena cava from the portal vein.
- In the veins are deeper than the arteries, i.e., the common iliac veins are deeper than the arteries, to protect the veins from pressure applied by the pregnant uterus to the thin-walled veins.
- Rather, this pressure is applied to arteries that have thick walls, making them less vulnerable.



Relations of IVC

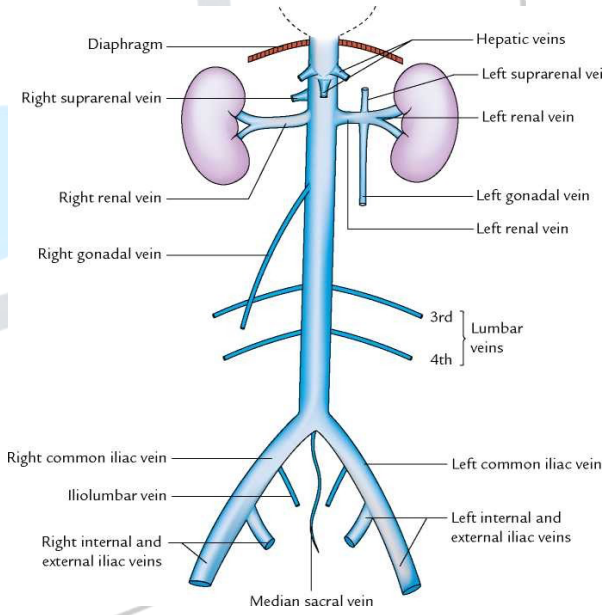
Anterior:

- Coils of the small intestine
- 3rd part & 1st part of duodenum
- Head of pancreas and CBD
- Related to the foramen of Winslow
- Portal vein
- Lies in the deep groove of the liver

Tributaries of I.V.C

The inferior vena cava has the following tributaries:

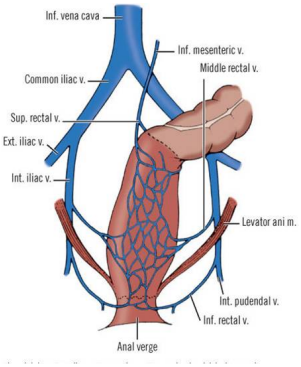
- Two **anterior** visceral tributaries: the hepatic veins
- Three **lateral** visceral tributaries: the right suprarenal vein (recall the clinical significance of the left vein draining into the left renal vein), renal veins, and right testicular or ovarian vein (again, the left branch drains into the left renal vein)
- Five lateral abdominal wall tributaries: the inferior phrenic vein and four lumbar veins
- Three veins of origin: two common iliac veins and the median sacral vein
- The left gonadal vein is more prone to varicocele; it is longer and more perpendicular than the right one



Veins of the Portal Circulation

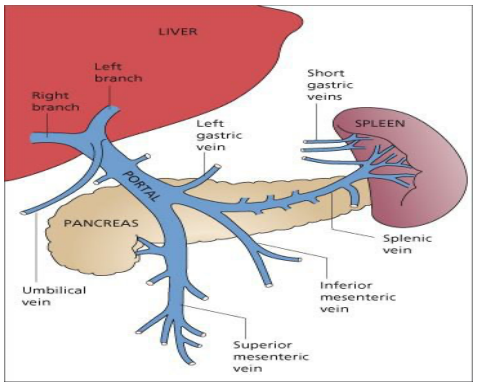
○ Inferior Mesenteric Vein

- The inferior mesenteric vein is a tributary of the portal circulation.
- It begins halfway down the anal canal as the superior rectal vein
- It passes up the posterior abdominal wall on the left side of the inferior mesenteric artery and the duodenojejunal flexure and joins the splenic vein behind the pancreas.
- It receives tributaries that correspond to the branches of the artery.



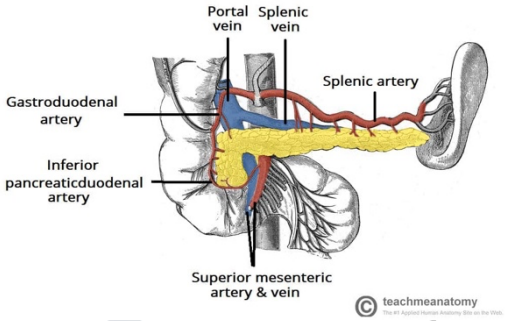
○ The Splenic Vein

- It is a tributary of the portal circulation.
- It begins at the hilum of the spleen by the union of several veins and is then joined by the short gastric and the left gastroepiploic veins.
- It passes to the right within the splenicorenal ligament and runs behind the pancreas.
- It joins the superior mesenteric vein behind the neck of the pancreas to form the portal vein. it is joined by veins from the pancreas and the inferior mesenteric vein.



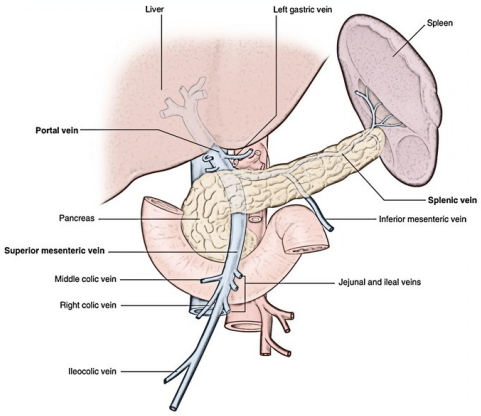
○ Superior Mesenteric Vein

- The superior mesenteric vein is a tributary of the portal circulation.
- It begins at the ileocecal junction and runs upward on the posterior abdominal wall within the root of the mesentery of the small intestine and on the right side of the superior mesenteric artery.
- It passes in front of the third part of the duodenum and behind the neck of the pancreas, where it joins the splenic vein to form the portal vein.
- It receives tributaries that correspond to the branches of the superior mesenteric artery and also receives the inferior pancreaticoduodenal vein and the right gastroepiploic vein.



Portal Vein

- The portal vein drains blood from the abdominal part of the gastrointestinal tract from the lower third of the esophagus to halfway down the anal canal; it also drains blood from the spleen, pancreas, and gallbladder.
- The portal vein enters the liver and breaks up into sinusoids, from which blood passes into the hepatic veins that join the inferior vena cava.
- It is about 2 in. (5 cm) long and is formed, as mentioned, behind the neck of the pancreas by the union of the superior mesenteric and splenic veins.
- It ascends to the right, behind the first part of the duodenum, and enters the lesser omentum.
- It then runs upward in front of the opening into the lesser sac to the porta hepatis, where it divides into right and left terminal branches
- The portal circulation begins as a capillary plexus in the organs it drains and ends by emptying its blood into sinusoids within the liver.



Tributaries of the Portal Vein

Splenic vein:

- This vein leaves the hilum of the spleen and passes to the right in the splenicorenal ligament.
- It unites with the superior mesenteric vein behind the neck of the pancreas to form the portal vein.
- It receives the short gastric, left gastroepiploic, inferior mesenteric, and pancreatic veins.

Inferior mesenteric vein:

- This vein ascends on the posterior abdominal wall and joins the splenic vein behind the body of the pancreas.
- It receives the superior rectal veins, the sigmoid veins, and the left colic vein.

Superior mesenteric vein:

- This vein ascends in the root of the mesentery of the small intestine.
- It passes in front of the third part of the duodenum and joins the splenic vein behind the neck of the pancreas.
- It receives the jejunal, ileal, ileocolic, right colic, middle colic, inferior pancreaticoduodenal, and right gastroepiploic veins.

Left gastric vein:

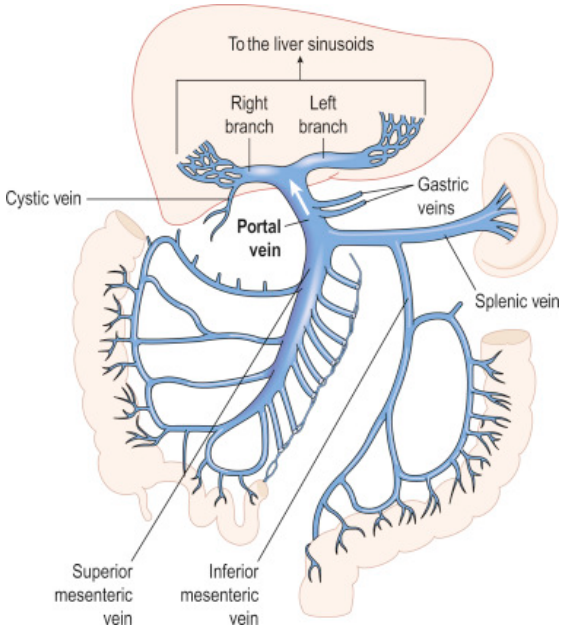
- This vein drains the left portion of the lesser curvature of the stomach and the distal part of the esophagus.
- It opens directly into the portal vein.

Right gastric vein:

- This vein drains the right portion of the lesser curvature of the stomach and drains directly into the portal vein.

Cystic veins:

- These veins either drain the gallbladder directly into the liver or join the portal vein.



[Portal systemic anastomosis]

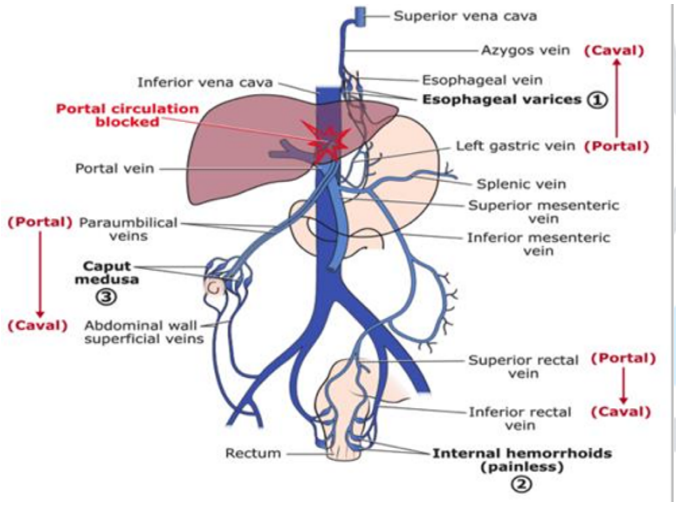
- A porta caval anastomosis (also known as portal systemic anastomosis or portal caval system) is a specific type of anastomosis that occurs between the veins of portal circulation and those of systemic circulation.
- The lower end of the esophagus is one of the important sites for the portosystemic anastomosis.
- In portal hypertension, as in the case of cirrhosis of the liver, the anastomosis opens and forms venous dilatation called esophageal varices.
- Their rupture causes severe and dangerous hematemesis.

Causes

- Liver diseases → Cirrhosis, fibrosis (bilharzial)
- Valvular diseases of the heart
- Congenital patent

Portal systemic anastomosis

Region	Name of clinical condition	Portal circulation	Systemic circulation
Esophageal	Esophageal varices	Esophageal branch of left gastric vein	Esophageal branches of Azygos vein
Rectal	Hemorrhoids	Superior rectal vein	Middle rectal veins and inferior rectal veins
Paraumbilical	Caput medusae	Paraumbilical veins	Superficial epigastric vein
Retroperitoneal	(no clinical name)	Right colic vein, middle colic vein, left colic vein	Renal vein, suprarenal vein, paravertebral vein, and gonadal vein
Intrahepatic	Patent ductus venosus	Left branch of portal vein	Inferior vena cava



[Lymphatics of the Posterior Abdominal Wall]

Lymph Nodes

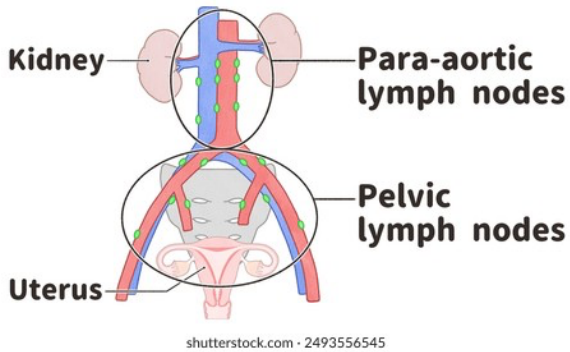
The lymph nodes are closely related to the aorta and form a pre-aortic chain, as well as right and left lateral aortic (para-aortic or lumbar) chains.

The Preaortic Lymph Nodes

- Lie around the origins of the celiac, superior mesenteric, and inferior mesenteric arteries and are referred to as the celiac, superior mesenteric, and inferior mesenteric lymph nodes, respectively.
- They drain the lymph from the gastrointestinal tract, extending from the lower one-third of the esophagus to halfway down the anal canal, and from the spleen, pancreas, gallbladder, and the greater part of the liver.
- The efferent lymph vessels form the large intestinal trunk.

The Lateral Aortic (Para-Aortic or Lumbar) Lymph Nodes

- Drain lymph from the kidneys and suprarenals; from the testes in the male and from the ovaries, uterine tubes, and fundus of the uterus in the female; from the deep lymph vessels of the abdominal walls; and from the common iliac nodes.
- The efferent lymph vessels form the right and left lumbar trunks



The Thoracic Duct

- Commences in the abdomen as an elongated lymph sac, the cisterna chyli. This lies just below the diaphragm in front of the first two lumbar vertebrae and on the right side of the aorta.

The Cisterna Chyli

- The right and left lumbar trunks under the diaphragm on the side of the aorta
- Receives lymph from:

- The intestinal trunk
- Some small lymph vessels that descend from the lower part of the thorax.
- Rt and lt vessels from the lower thorax

The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

The Anterior Abdominal Wall

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[Overview]

➔ **Outline of The Abdominal Wall:**

1) Anterior Abdominal Wall
2) Rectus Sheath
3) Lumbar Triangle
4) Clinical Notes

[Anterior Abdominal Wall]

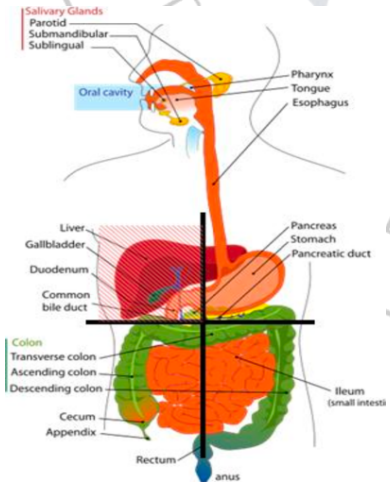
Borders of the Abdomen

- Abdomen is the region of the trunk that lies between the diaphragm above and the inlet of the pelvis below

- Superior:
  - Costal cartilages 7-12.
  - Xiphoid process
- Inferior:
  - Pubic bone and iliac crest (level of L4).
- Umbilicus:
  - Level of intervertebral disc L3-L4

Abdominal Quadrants

- Formed by two intersecting lines: a vertical line and a horizontal one that intersect at the umbilicus, forming these 4 regions, also known as quadrants:
  - Upper left
  - Upper right
  - Lower left
  - Lower right



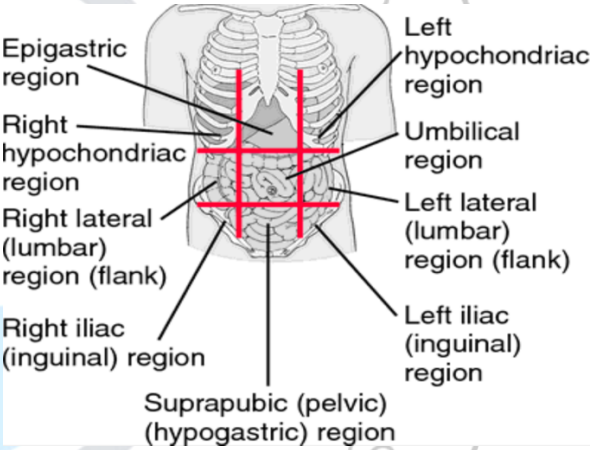
Abdominal Regions

- Divided into 9 regions by two **pairs** of planes:

1. Vertical Planes:
   - Right and left lateral (midclavicular) planes
   - Each passes vertically through the midpoint between the anterior superior iliac spine (ASIS) and symphysis pubis

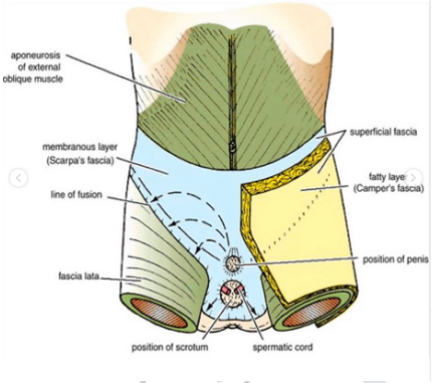
2. Horizontal Planes:
   - **Subcostal plane**
     - Located at the level of L3 vertebra
     - Connects the inferior end of costal cartilage on each side
   - **Intertubercular plane**:
     - Located at the level of L5 vertebra
     - Passes through the tubercles of iliac crests.

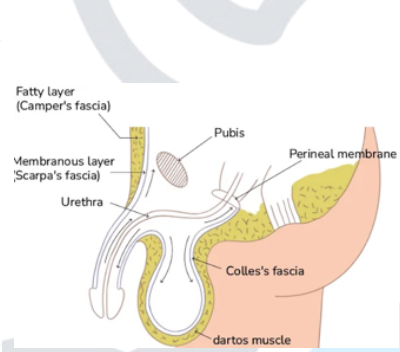
Pinpoint those planes on the figure below.



Anterior Abdominal Wall Layers

- Skin
- Superficial Fascia
  - Above the umbilicus, consists of one layer
  - Below the umbilicus, divides into two layers:
    - **Camper's fascia**: fatty superficial layer, continues into the scrotum to form dartos fascia/muscle in males
    - **Scarpa's fascia**: deep membranous layer, continues into the perineum as Colle's fascia
      - Attachments (Scarpa's): inferiorly to the fascia lata of the thigh, laterally to the pubic arch, posteriorly to the perineal body
  - Clinical correlation: rupture of the penile (spongy) urethra leads to extravasation of urine into the scrotum, perineum, penis, and abdomen (but not the thigh!).

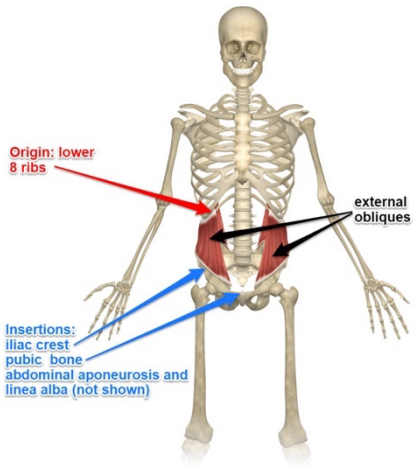




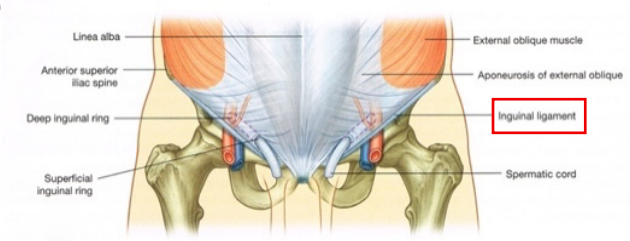
- Deep fascia:
  - Thin layer of connective tissue covering the muscle (may be absent).
- Muscular layer
  - External oblique muscle
  - Internal oblique muscle
  - Transverse abdominal muscle
  - Rectus abdominis
- Transversalis fascia
- Extraperitoneal fascia
- Parietal Peritoneum

Abdominal Wall Muscles

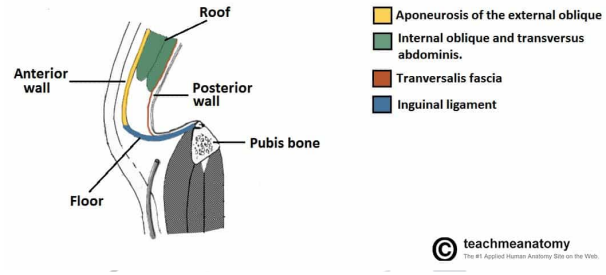
1. External Oblique Muscle
   - **a. Features**
   - Broad
   - Thin
   - **b. Direction**:
   - Downward, forward, medial
   - **c. Insertion**:
   - Xiphoid process
   - Linea alba
   - Pubic crest
   - Pubic tubercle
   - Iliac crest (anterior half)
   - **d. Nerve Supply**:
   - Lower 6th thoracic nerves
   - L1
     - Iliohypogastric nerve
     - Ilioinguinal nerve

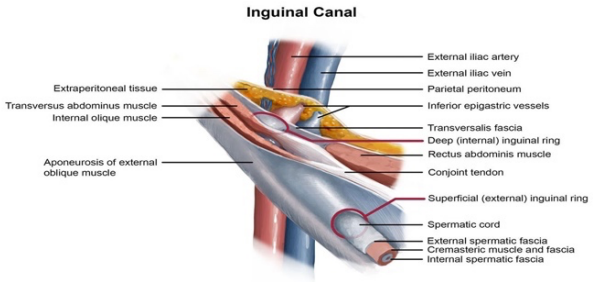


- **e. Aponeurosis:**
  The aponeurosis of the external oblique muscle forms several important structures:
  - Inguinal Ligament:
    - Formed by the inferior border of the aponeurosis of external oblique muscle folding on itself.
    - Extends between ASIS and the pubic tubercle

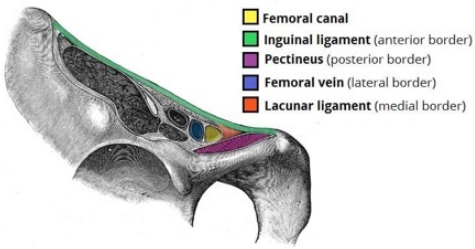


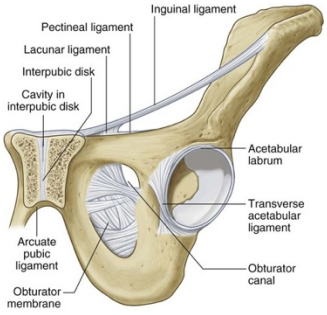
- Superficial Inguinal Ring
  - A triangular-shaped defect in the external oblique aponeurosis
  - Lies immediately above and medial to the pubic tubercle
  - Serves an opening for structures exiting the inguinal canal: the spermatic cord (M) or round ligament of uterus (F)



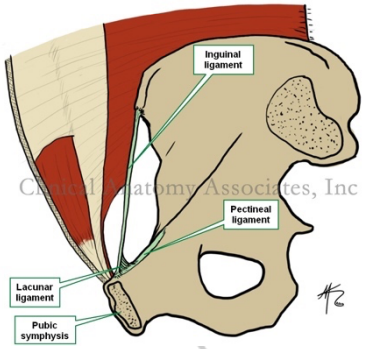


- Lacunar Ligament
  - A medial extension of the inguinal ligament.
  - Formed by fibers of the aponeurosis of the EOM passing backward and upward to the pectineal line.
  - Attaches to the superior ramus of the pubis
  - Its sharp, free crescentic edge forms the medial margin of the femoral ring





- Pectineal Ligament
  - A lateral continuation of the lacunar ligament running along the pectineal line
  - Blends with the thickening of the periosteum



2. Internal Oblique Muscle
   a. **Direction of Fibers**:
   - Run upwards, forwards, medially (perpendicular to EO fibers)

   b. **Origin:**
   - Lumbar fascia
   - Anterior 2/3 of the iliac crest
   - Lateral 2/3 of the inguinal ligament

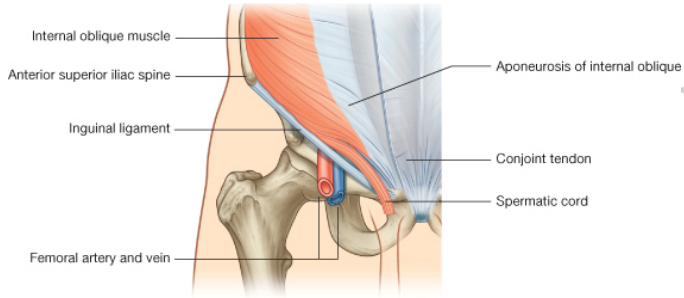
   c. **Insertion**:
   - Inferior border of lower 3 ribs and their costal cartilages
   - Xiphoid process
   - Linea alba
   - Symphysis pubis

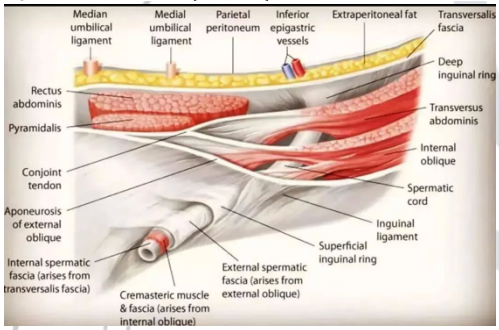
   d. **Nerve Supply**:
   - Lower 6 thoracic nerves (T7-T12)
   - L1:
     - Iliohypogastric nerve
     - Ilioinguinal nerve

   e. **Conjoint Tendon:**
   - Formed by the fusion of the lowest tendinous fibers of internal oblique and transversus abdominis
   - Attach medially to linea alba
   - Supports the inguinal canal (its roof)
   - Has a lateral free border

f. Cremasteric Fascia & Muscle:

- The lower fibers of the internal oblique arch over the spermatic cord or the round ligament of the uterus
- These fibers give rise to:
  - Cremasteric muscle
  - Cremasteric fascia





3. Pyramidalis Muscle

a. Origin:

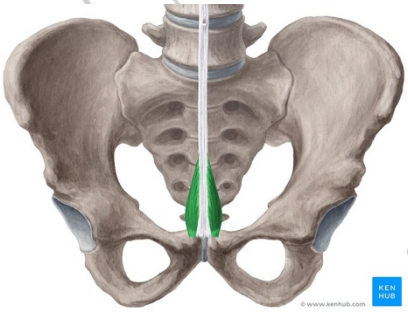
- Anterior surface of the pubis

b. Insertion:

- Linea alba
- It lies in front of the lower part of the rectus abdominis muscle

c. Nerve Supply:

- 12th subcostal nerve



4. Transverse Abdominal Muscle

a. Direction of fibers:

- Horizontally, forwards, deep to the internal oblique

b. Origin:

- Inner surface of lower 6 cartilages (7-12)
- Lumbar fascia
- Anterior 2/3 of the iliac crest
- Lateral 1/3 of the inguinal ligament

c. Insertion:

- Xiphoid process
- Linea alba
- Symphysis pubis

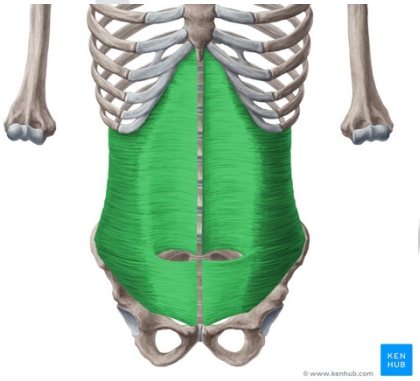
The lower fibers fuse with the internal oblique to form the conjoint tendon, which attaches to the pubic crest and pectineal line

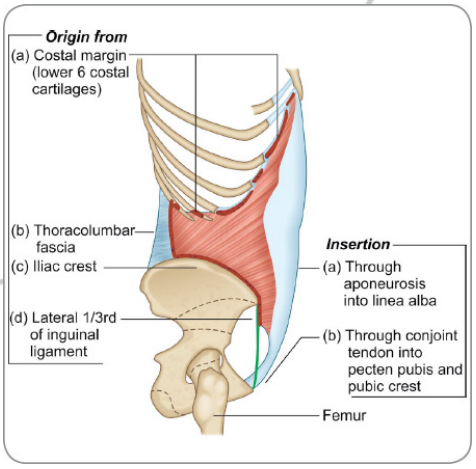
d. Nerve Supply:

- Lower 6 thoracic nerves (T7-T12)
- L1
  - Iliohypogastric nerve
  - Ilioinguinal nerve

e. Function:

Assists in the formation of the conjoint tendon and rectus sheath



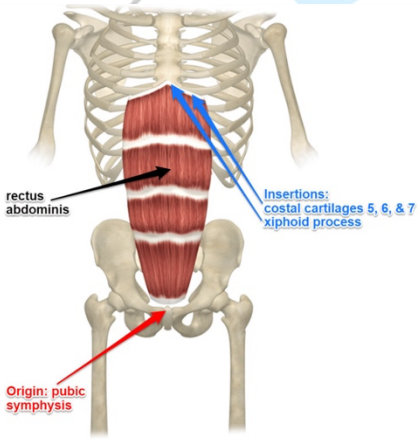


5. Rectus Abdominis
   a. **Features**:
- Long strap muscle
- Extends along the whole length of the anterior abdominal wall
- Enclosed within the rectus sheath

   b. **Origin:**
- Symphysis pubis
- Pubic crest

   c. **Insertion**:
- 5th, 6th, 7th costal cartilages
- Xiphoid process

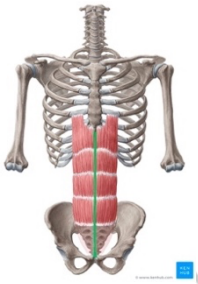
   d. **Nerve Supply**:
- Lower 6 thoracic nerves (T7-T12)



➔ **Action of the Anterior Abdominal Muscles**
- Deep expiration
- Increase intraabdominal pressure during:
  - Vomiting
  - Cough
  - Defecation
  - Labor
- Protect viscera
- Maintain viscera in position
- Rectus abdominis → flexes trunk forwards

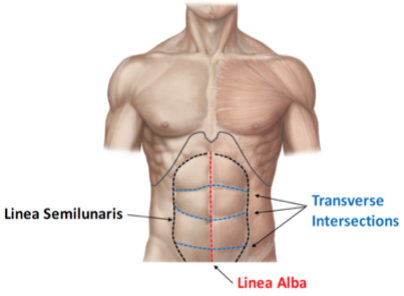
Lines and Landmarks of the Anterior Abdominal Wall

1. Linea Alba
- Located along the midline
- Extends from the xiphoid process to the symphysis pubis
- Formed by the fusion of the aponeuroses of the three abdominal wall (EO, IO, TA)



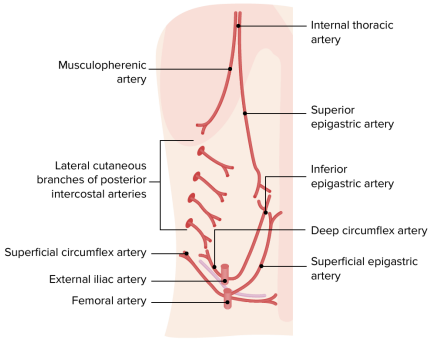
2. Linea Semilunaris
- Mark the lateral margins of the rectus abdominus muscle
- Extend from the 9th costal cartilage to the pubic tubercle
- Can be palpated on physical exam

3. Tendinous Intersection- Linea Transverse
- 3 transverse fibrous bands dividing the rectus abdominis muscle into distinct segments at:
  a. Xiphoid level
  b. Umbilical level
  c. Midway between the two
- They can be palpated as a transverse depression and give the “six pack” appearance

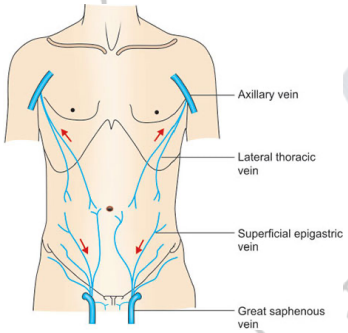


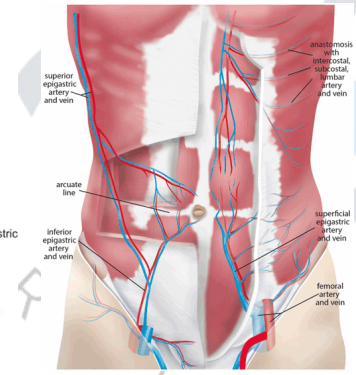
Blood Supply of the Anterior Abdominal Wall

1. Arteries:
   a. Superior epigastric artery
   b. Inferior epigastric artery
   c. Intercostal arteries
   d. Lumbar arteries
   e. Deep circumflex iliac artery

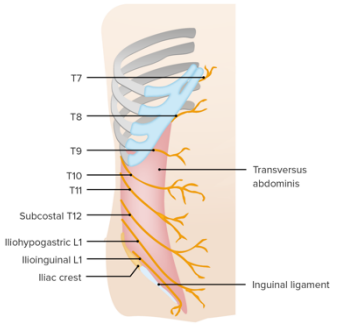


2. Veins:
   a. Above the umbilicus
      - Lateral thoracic → Axillary vein
   b. Below the umbilicus
      - Inferior epigastric → Femoral vein
   c. Paraumbilical veins
      - Ligamentum teres → Portal vein (**porto-systemic anastomosis!**)



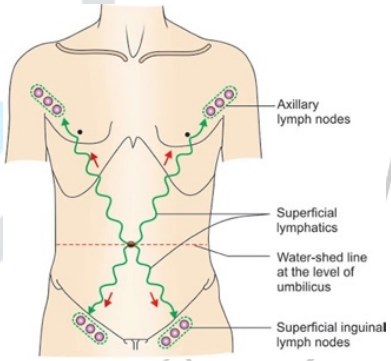


3. Nerve Supply:
   a. Thoracoabdominal nerves (T7-T12) + 12th subcostal nerve
   b. Dermatomes
      - T7: above umbilicus (below xiphoid)
      - T10: umbilicus
      - L1: below umbilicus (above pubis)
   c. L1 nerve branches:
      - Iliohypogastric nerve
      - Ilioinguinal nerve



4. Lymphatic Drainage

Above umbilicus → Axillary nodes
Below umbilicus → Superficial inguinal nodes
Above iliac crest → Posterior axillary nodes
Below iliac crest → Superficial inguinal nodes



Additional Fascial Layers of the Anterior Abdominal Wall

1. Transversalis Fascia
   - A thin layer of fascia that lines the transverse abdominis muscle
   - Continuous with the diaphragm, iliac muscle, and pelvis fascia
   - Contributes to the femoral sheath

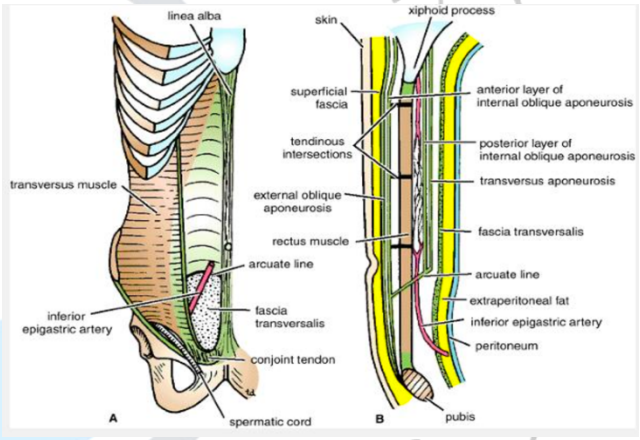
2. Extraperitoneal Fascia
   - Thin layer of connective tissue and adipose tissue
   - Lies between the peritoneum and fascia transversalis

3. Parietal Peritoneum
   - Thin serous membrane
   - Lines the abdominal cavity
   - Continuous below with the parietal peritoneum lining the pelvis

[Rectus Sheath]

➔ **Definition:**
- The rectus sheath is a long fibrous sheath enclosing the rectus abdominis
- Formed mainly by the aponeuroses of the three lateral abdominal muscles
- The **anterior** wall is firmly attached by the muscle's tendinous intersections
- The **posterior** wall of the rectus sheath is not attached to the rectus abdominis muscle

➔ **Contents:**
- Rectus abdominis muscle
- Pyramidalis muscle (if present)
- Anterior rami of T7-T12 nerves
- Superior and inferior epigastric vessels
- Lymphatic vessels

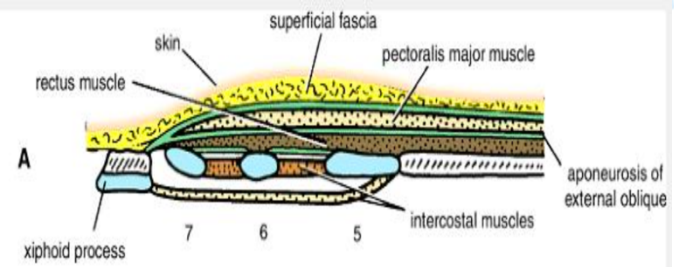


The description of the rectus sheath can be considered in more detail at three different levels:
- Above the costal margin
- Between the costal margin and the level of the anterior superior iliac spine (ASIS)
- Between the level of the ASIS and the pubis

Above the Costal Margin

Anterior wall:
- Skin
- Superficial fascia
- Deep fascia to the muscles
- Pectoralis major muscle
- Aponeurosis of external oblique

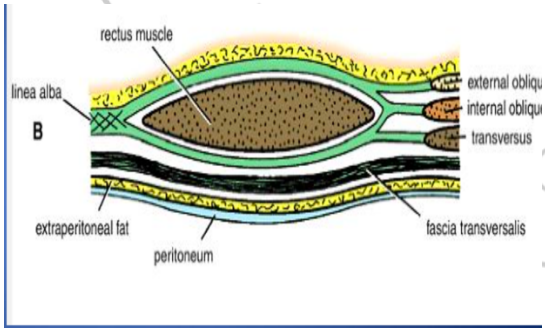
Posterior wall:
- Xiphoid process
- The 5^{th}+6^{th}+7^{th} costal cartilages
- The intercostal spaces



Between the costal margin and the level of the anterior iliac spine

Anterior wall:
- Skin
- Superficial fascia
- Aponeurosis of external oblique
    - Directed in front of the muscle
- Anterior layer of internal oblique
    - Aponeurosis of the internal oblique muscle splits to enclose the rectus muscle

Posterior wall:
- Posterior layer of internal oblique
- Transversus abdominis



Between the level of the anterosuperior iliac spine and the pubis

Anterior wall:
- The aponeurosis of all three muscles

Posterior wall:
- ABSENT
- The rectus muscle lies in contact with the fascia transversalis

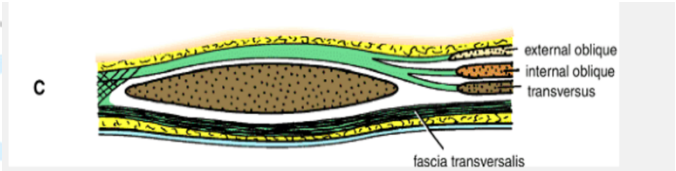
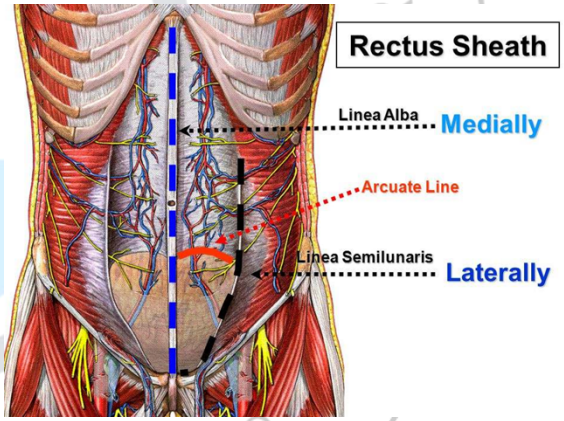


Figure 4-13 Transverse sections of the rectus sheath seen at three levels. **A**. Above the costal margin. **B**. Between the costal margin and the level of the anterior superior iliac spine. **C**. Below the level of the anterior superior iliac spine and above the pubis.

➔ **Linea Semicircularis (Arcuate Line)**
A crescent-shaped line marking the lower limit of the posterior rectus sheath just below the level of the iliac crest



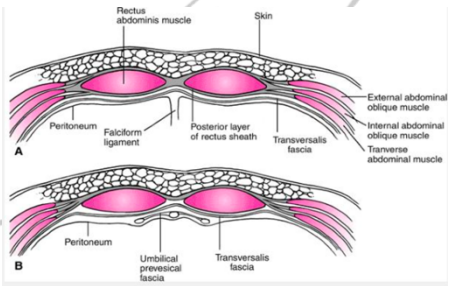


Figure 5-2 Arrangement of the rectus sheath above the umbilicus (upper) and below the arcuate line (lower).

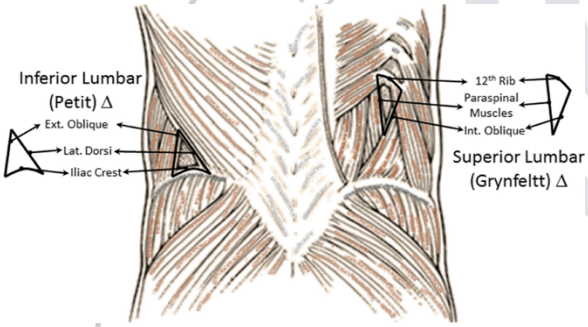
[Lumbar Triangle]

There are two lumbar triangles:

1. The inferior lumbar triangle (Petit)
Lies superficially

2. The superior lumbar triangle (Grynfeltt)
Lies deep and superior to the inferior triangle.

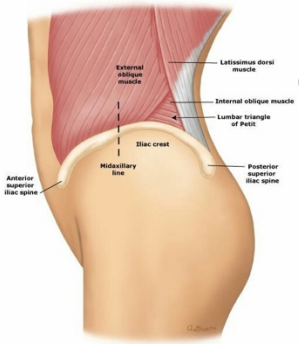
Of the two, the **superior** (but not superficial) triangle is the one more consistently found in cadavers, and is also the more common site of herniation
Even so, it is the inferior lumbar triangle that is sometimes referred to simply as "the lumbar triangle", perhaps owing to its more superficial location and ease in demonstration (when present).



Inferior Lumbar Triangle (Petit)

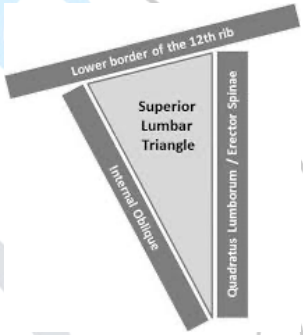
Boundaries:
- **Medially**
  - Latissimus dorsi muscle
- **Laterally**
  - External abdominal oblique muscle
- **Inferiorly**
  - By the iliac crest

Floor: Internal abdominal oblique muscle
  - Herniation *occasionally* occurs here



Superior Lumbar Triangle (Grynfeltt – Lesshaft)

Boundaries:
- **Medially**
  - Quadratus lumborum muscle
- **Laterally**
  - Internal abdominal oblique muscle
- **Superiorly**
  - The 12th rib
- **The floor**
  - Transversalis fascia
- **The Roof**
  - External abdominal oblique muscle



[Clinical Notes]

Abdominal Stab Wounds

The effect depends on which layer is penetrated:

- Midline wounds may involve the linea alba, which is avascular but has poorer healing
- Lateral wounds may involve rectus sheath or muscles

Surgical Incisions

The length and direction of surgical incision through the anterior abdominal wall to expose the underlying viscera are largely controlled by:

1. Position and direction of nerves
2. Direction of muscle fibers
3. Arrangement of the aponeurosis forming the rectus sheath

The incision should be made in the direction of the line of cleavage in the skin (the normal tension lines) so that a hairline scar is produced

➔ Incision through the rectus sheath

- Widely used
- The rectus abdominis muscle and its nerve supply are kept intact
- On closure, the anterior and posterior walls of the sheath are sutured individually, and the rectus muscle is placed back into position between them

➔ Common types of incisions

- Paramedian incision
- Pararectus incision
- Midline incision
- Transrectus incision
- Transverse incision
- Muscle splitting
- Abdominothoracic incision

The University of Jordan
Gastroenterology Interest Group (UJ-GIG)
Booklet

Anatomy

The Liver

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[Overview]

➔ **Outline of The Liver:**

1) **Liver Surfaces + View**
2) **Lobes of the Liver**
3) **Segments of the Liver**
4) **Histology of the Liver**
5) **Ligaments of the Liver**
6) **Blood Supply of the Liver**

➔ **General features of the liver**

- The liver is the largest gland in the body and has a wide variety of functions
- Weight:
  - ~1/50 of body weight in adults ~1/20 of body weight in infant
- It is both an exocrine→bile and endocrine organ→albumin, prothrombin and fibrinogen)
- Functions of the liver:
  - Secretion of bile and bile salts
  - Metabolism of carbohydrates, fats, and proteins
  - Formation of heparin and anticoagulant substances
  - Detoxification of drugs or toxins
  - Storage of glycogen and vitamins
  - Activation of vitamin D
- Location:
  - Occupies the right hypochondrium + epigastrium.
  - Extends to the left hypochondrium

➔ **Peritoneal relations of the liver**

- The liver is an intraperitoneal organ, i.e., itiis covered by peritoneum except at the bare area (derived from the septum transversum)
- The inferior surface is covered by the peritoneum of the greater sac except at the porta hepatis, the gallbladder fossa, and the ligamentum teres fissure
- The right lateral surface is covered by peritoneum and related to the diaphragm, which separates it from the right pleura, rt. lung and rt. ribs (6-11)

[Liver Surfaces + View]

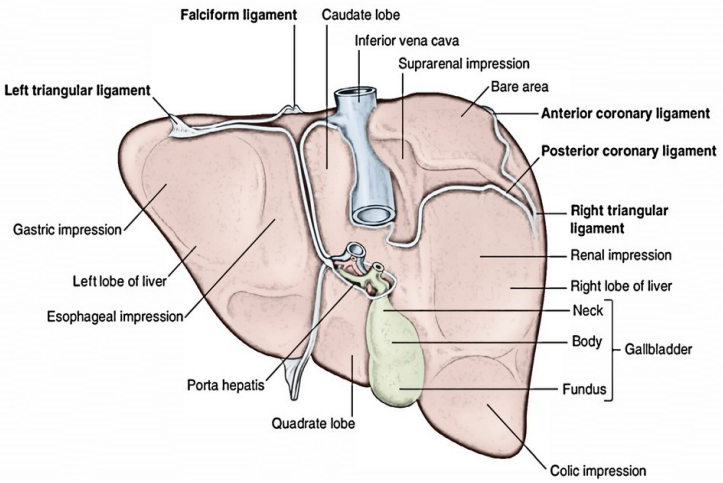
- Most of the liver is situated under the right costal margin
- Diaphragm separates it from the pleura, lungs, pericardium, and heart.

Anterior view of the Liver

- Structures:
  - Right lobe
  - Cut edge of the falciform ligament
  - Left lobe
  - Cut edges of the superior part of the coronary ligament
  - Fundus of the gallbladder
- Relations:
  - Diaphragm
  - Rt and lt pleura and lung
  - Costal cartilages
  - Xiphoid process
  - Anterior abdominal wall

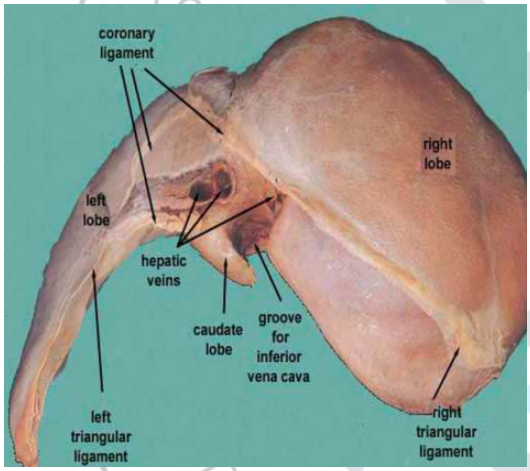
Posterior-inferior surface = visceral surface

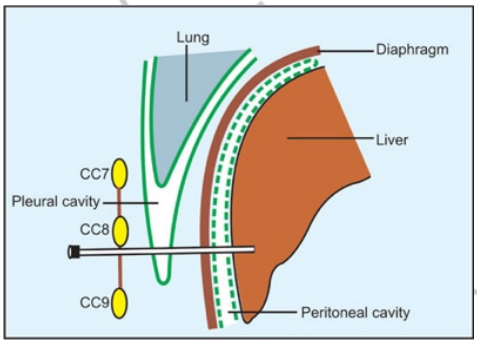
- Relations
  - IVC
  - Esophagus
  - Stomach
  - Duodenum
  - Right colic (hepatic) flexure
  - Right kidney
  - Right suprarenal gland
  - Gallbladder.
  - Porta hepatis, which consists of:
    - Bile duct
    - Hepatic artery
    - Portal vein
  - Fissure for ligamentum venosum and lesser omentum
  - Tubular omentum
  - Fissure for ligamentum teres



Superior Surface

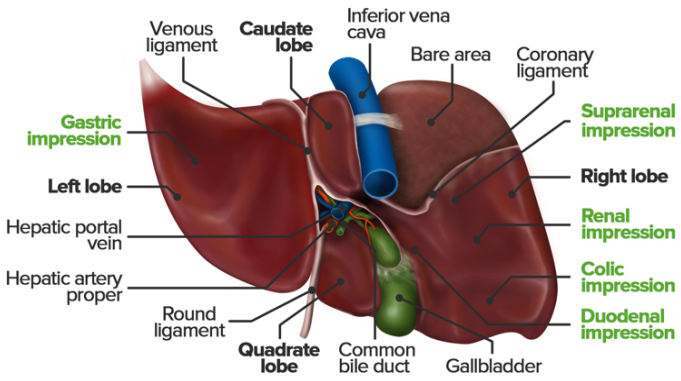
- Structures
  - Right and left lobes
  - Falciform ligament (cut edge)
  - Coronary ligaments (cut edges of the superior and inferior parts)
  - Left triangular ligament
  - Right triangular ligament
  - Bare area of the liver
    - Remember: it's where there is no peritoneum!
  - Groove for the IVC and hepatic veins
  - Caudate lobe of the liver (which wraps around the groove of the inferior vena cava)
  - Fundus of gallbladder
  - Ligamentum teres
- Relations
  - Diaphragm
  - Pleura and lungs
  - Pericardium and heart





Posterior Surface

- Relations:
  - Diaphragm
  - Right kidney
  - Right suprarenal gland
  - Transverse colon (hepatic flexure)
  - Duodenum
  - Gallbladder
  - IVC
  - Esophagus
  - Fundus of the stomach

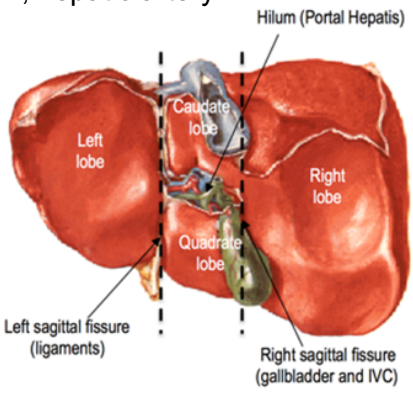


[Lobes of the Liver]

There are 4 anatomical lobes to the liver: right, left, caudate, and quadrate

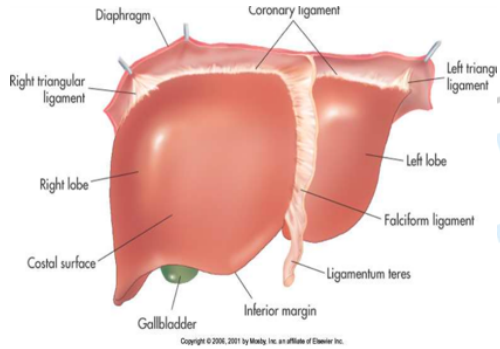
➔ **Separation of the four lobes of the liver**
These lobes are separated by surface landmarks (H-shaped):

- Right sagittal fissure
  - Groove for the inferior vena cava and gallbladder
- Left sagittal fissure
  - Contains the ligamentum venosum (posteriorly) and round ligament of liver (anteriorly)
- Transverse fissure (porta hepatis)
  - As we said, contains: bile ducts, portal vein, hepatic artery



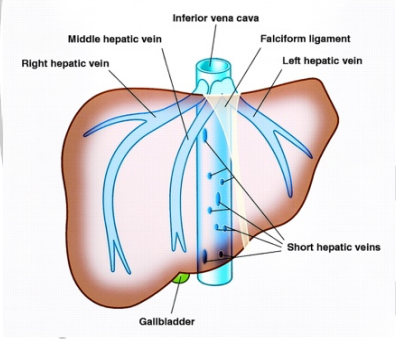
Right Lobe

- Largest lobe
- Occupies the right hypochondrium
- Divided into anterior and posterior sections by the **right hepatic vein**
- Reidel's lobe is sometimes found; a downward extension that can project as far caudally as the iliac crest



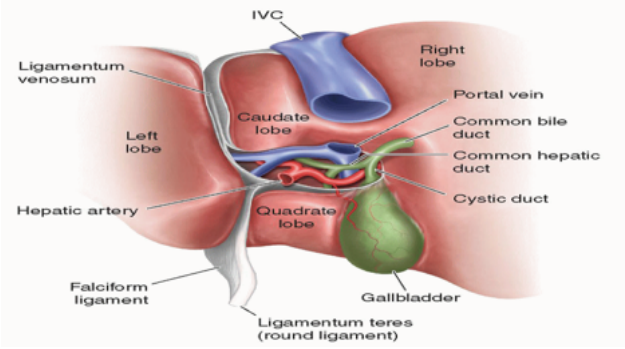
Left Lobe

- Variable in size
- Lies in the epigastrium and left hypochondrium
- Divided into medial and lateral segments by the left hepatic vein



➔ **Rt and lt lobes are separated by:**

- Falciform ligament
- Ligamentum venosum
- Ligamentum teres

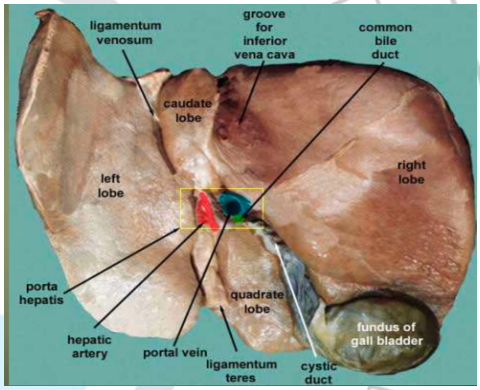


Caudate Lobe

- Located on the posterior surface
- Functionally part of the right lobe
- <u>Two processes:</u>
  - Caudate process
  - Papillary process
- <u>Relations:</u>
  - Inferiorly → the porta hepatis
  - Right → IVC groove
  - Left → ligamentum venosum fissure

Quadrate Lobe

- Located on the inferior surface of the right lobe
- <u>Relations:</u>
  - Anteriorly → anterior margin of the liver
  - Superiorly → porta hepatis
  - Right → fossa for the gallbladder
  - Left → fissure for ligamentum teres



➔ **Porta Hepatis**

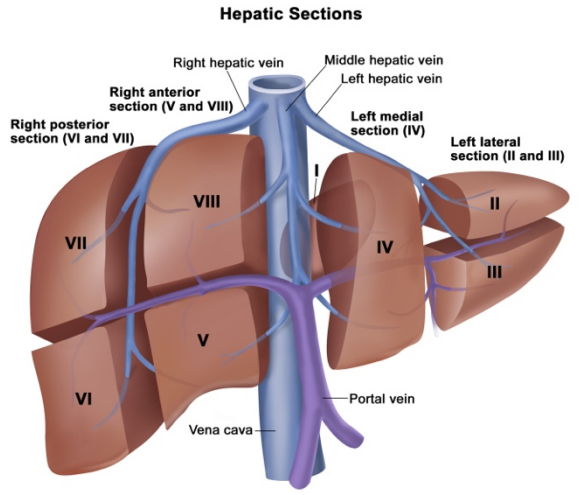
- We've mentioned this a couple of times; let's go over the most important details you need to know about this structure.
- It is the hilum of the liver (i.e., entry/exit point)
- It is found on the posteroinferior surface
- Lies between the caudate and quadrate lobes
- The lesser omentum attaches to its margin
- <u>Contents (anterior to posterior):</u>
  - Bile duct
  - Hepatic artery + nerves + lymphatics
  - Portal vein

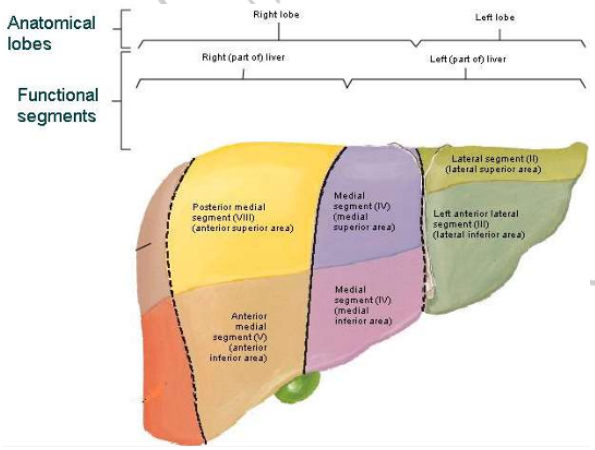
[Segmental Anatomy of the Liver]

The liver is divided into segments based on vascular supply and biliary drainage rather than anatomical appearance.

Anatomical division by ligaments (falciform ligament, ligamentum venosum, and ligamentum teres)

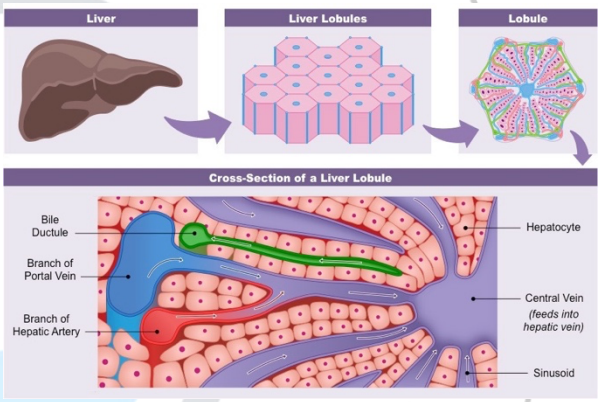
- True functional division is along a line extending from the fossa of the gallbladder to the fossa of the IVC.
- Each functional division has its own arterial blood supply, venous inflow, and biliary drainage
- No anastomosis between divisions (surgically independent)
- Recall the 3 major hepatic veins → rt, lt and central
- **8** segments based on hepatic and portal venous branching

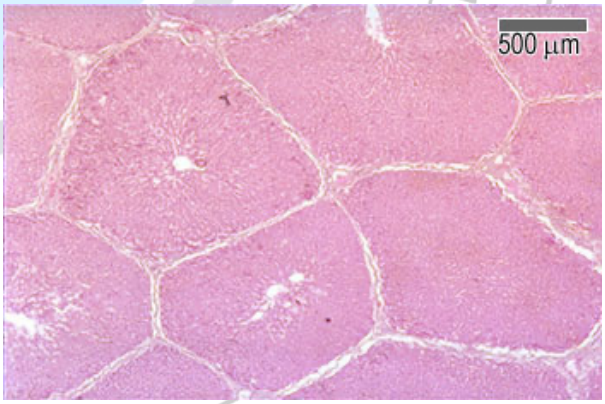


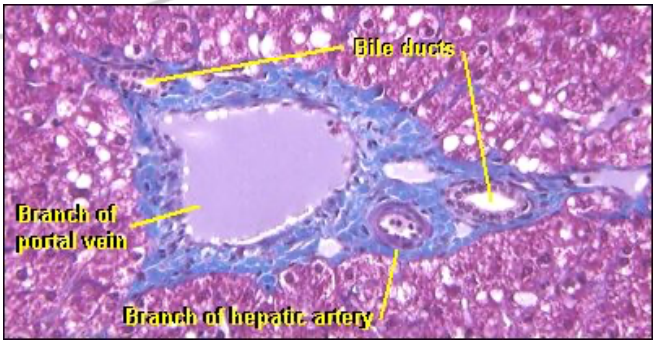


[Liver Histology]

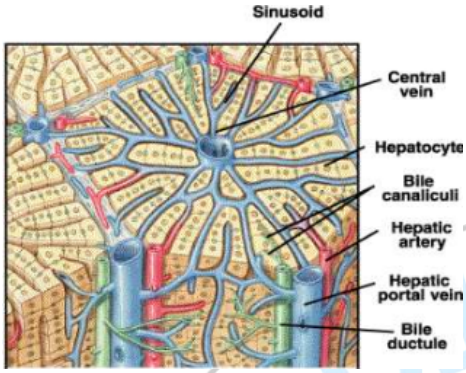
- The liver is composed of repeating structural units called “lobules”.
- They are roughly hexagonal structures consisting of hepatocytes.
- These units are grossly separated by septa radiating into the parenchyma from a thin capsule surrounding the liver at the porta hepatic (it is thick) → Glisson’s capsule invests the liver and sends septa into the liver subset, subdividing the parenchyma into lobules
- The cells (hepatocytes) radiate outward from a central vein.
- At each of the six corners of a lobule is a portal triad consisting of: portal arteriole (from the hepatic artery), portal venule, and bile duct
- Between the hepatocytes are the liver sinusoids (specialized capillary spaces).





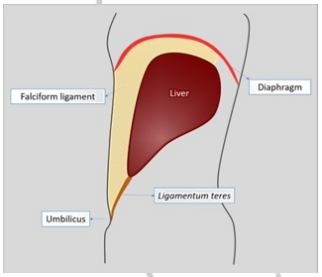


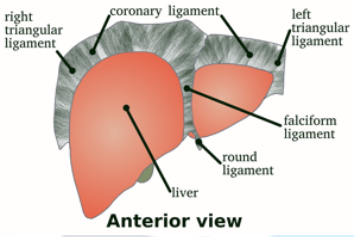
➔ **Where do the two blood supplies mix?**
Blood from the portal vein and hepatic artery mixes within the liver sinusoids before draining into the central vein.



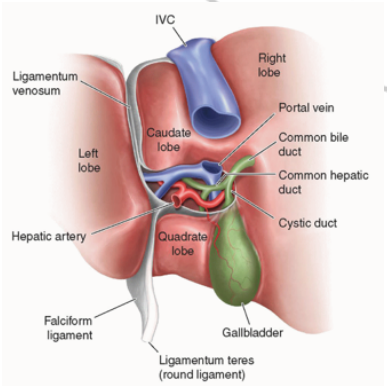
[Ligaments of the Liver]

1. Falciform Ligament
- Consists of a double layer of peritoneum
- Sickle-shaped
- Extends from the anterior abdominal wall (umbilicus) to the liver
- Its free inferior border contains ligamentum teres hepatis (obliterated umbilical vein)

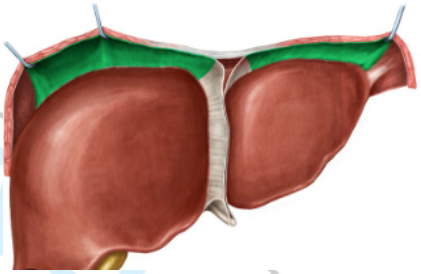




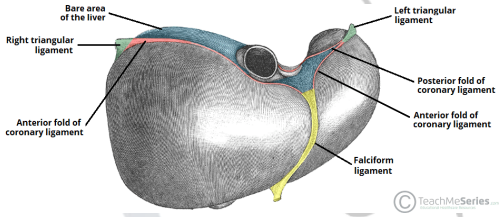
2. Ligamentum Teres Hepatis (Round Ligament)
- Fibrous remnant of the left umbilical vein
- Located in the free margin of the falciform ligament
- Runs from the umbilicus to the inferior surface of the liver



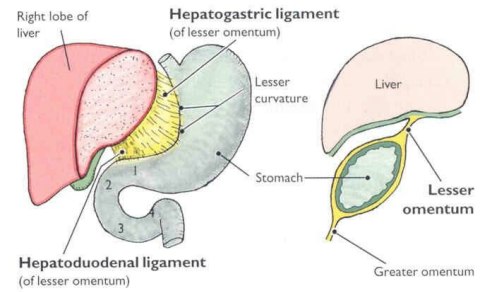
3. The Coronary Ligament
- Reflects from diaphragm to superior surface of the liver
- Has upper and lower layers
- The area between those layers is the bare area of liver, which is in direct contact with the diaphragm.



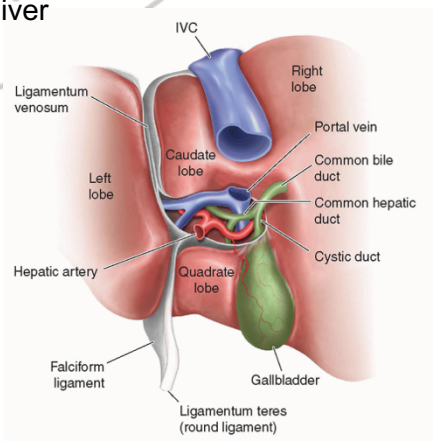
4. Right and Left Triangular Ligaments



5. Hepatogastric and Hepatoduodeal Ligaments
- Part of the lesser omentum
- Hepatoduodenal ligament contains the portal triad



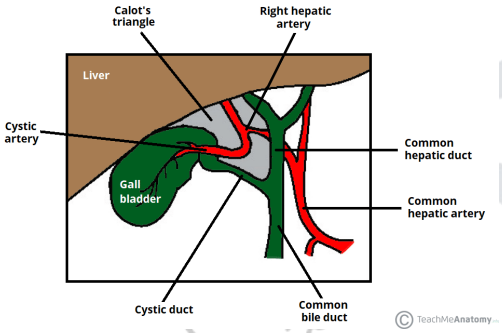
6. The Ligamentum Venosum
- Fibrous remnant of the ductus venosus
- Extends from the left branch of the portal vein to the portal vein through a fissure in the liver

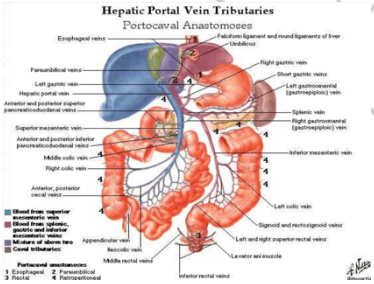


[Blood Supply of the Liver]
Arterial Supply

- From the **proper hepatic artery** → divides into right and left hepatic arteries → enter the porta hepatis.
- The right hepatic artery usually gives off the cystic artery, which runs to the neck of the gallbladder.
- The blood vessels conveying blood to the liver are the hepatic artery (with a contribution of 30%) and the portal vein (70%).
- The hepatic artery provides oxygenated blood to the liver, while the portal vein brings nutrient-rich venous blood, which has been absorbed from the gastrointestinal tract.
- If you recall, we mentioned that the blood from these sources is conducted to the central vein of each liver lobule by the liver sinusoids (where they mix).
- The central veins drain into the right and left hepatic veins, and these leave the posterior surface of the liver and open directly into the inferior vena cava.

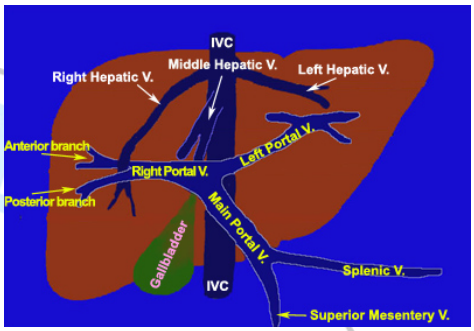
central veins→hepatic veins→IVC





Venous Drainage

- The portal vein divides into right and left terminal branches that enter the porta hepatis behind the arteries.
- The hepatic veins (usually three or more) emerge from the posterior surface of the liver and drain into the inferior vena cava.



Lymphatic Drainage

- Liver produces a large amount of lymph (around one third to one half of total body lymph!)
- Lymph leaves the liver and drains into several lymph nodes in the porta hepatis → their efferent vessels pass onto the celiac nodes
- A few vessels pass from the bare area of the liver → the diaphragm → posterior mediastinal lymph nodes.

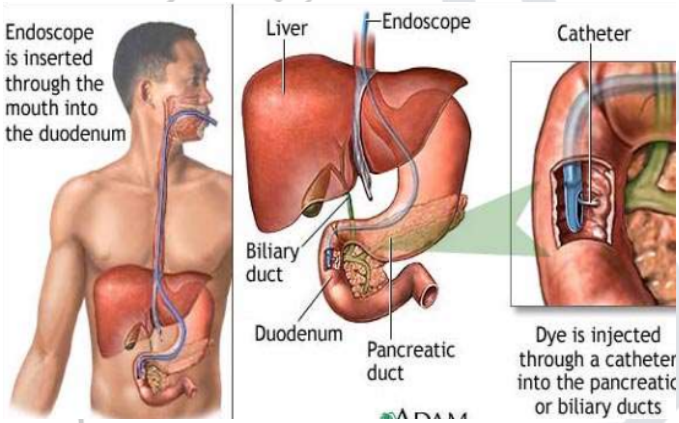
Nerve Supply

- Sympathetic → celiac plexuses (originates from thoracic ganglion chain T1-T12)
- Parasympathetic → vagus nerve (anterior trunk)
- Both form the hepatic plexus.
- The anterior vagal trunk gives rise to a large hepatic branch, which passes directly to the liver.

[Clinical Pearls]

➔ ERCP: endoscopic retrograde colangiopancreaticography

- It is a technique that combines the use of endoscopy and fluoroscopy to diagnose and treat certain problems of the biliary or pancreatic ductal systems.
- Through the endoscope, the physician can enter the inside of the stomach and duodenum and inject dye into the ducts in the biliary tree and pancreas so they can be seen on X-rays.
- ERCP is used primarily to diagnose and treat conditions of the bile ducts, including gallstones, inflammatory strictures (scars), leaks (from trauma and surgery), and cancer.



➔ Liver cirrhosis

Chronic liver disease is characterized by:

- Fibrosis
- Regenerative nodules
- Distortion of normal architecture

Key consequences:

- Portal hypertension
- Ascites
- Splenomegaly
- Varices (esophageal, gastric)
- Impaired liver function