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HUMAN ANATOMY AND PHYSIOLOGY – II

UNIT 2

TOPIC :

- **Digestive system**

Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.

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Digestive System

- Raw materials are utilised by the cells for production of energy which is further consumed for different synthetic processes.
- The external environment provides these raw materials in the form of food.
- The digestive system transfers nutrients from the external environment (in the form of food) to the internal environment (via ingestion of food).
- In the internal environment, nutrients are distributed to different cells of the body via circulatory system.
- Digestive system includes the alimentary canal (gastrointestinal tract), some accessory digestive glands, and a range of digestive processes which take place at different levels in the alimentary canal for the absorption of digested food.
- The process of breakdown and absorption of the consumed food is termed as digestion.
- It involves the following processes:
 - Mechanical breakdown of food by processes like chewing, mixing, churning, and segmentation.
 - Chemical breakdown of food into their chemical building blocks via digestive enzymes present in the secretion of digestive glands and the accessory organs of the digestive system.

Anatomy of Digestive Intestinal Tract (GIT)

- The alimentary canal (or the gastrointestinal or digestive tract) begins at the mouth and terminates at the anus.
- All the different parts are named separately, though they are more or less similar in structure.

- After ingestion the food passes through this long tube to reach the stomach and intestines for further digestion, absorption, and assimilation.
- Different parts of the alimentary canal include:
 - Oral cavity (mouth),
 - Pharynx,
 - Oesophagus,
 - Stomach,
 - Small intestine,
 - Large intestine, and
 - Accessory organs of the digestive system:
 - i) Three pairs of salivary glands,
 - ii) Pancreas,
 - iii) Liver, and
 - iv) Gall bladder

Oral Cavity (Mouth)

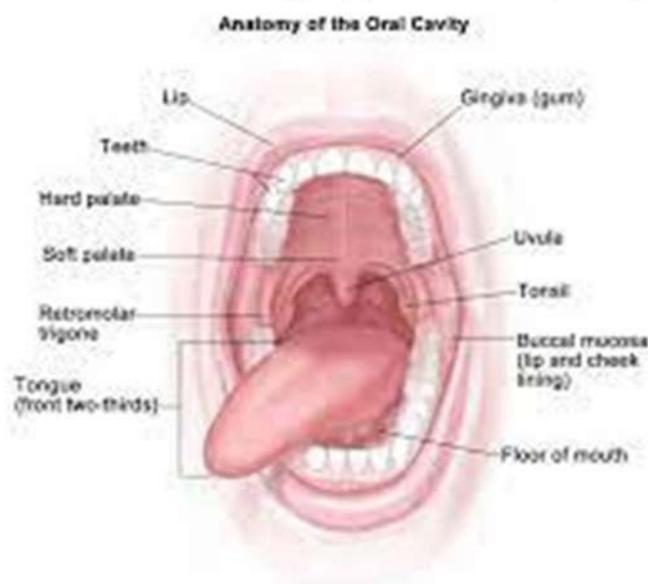
→ Oral cavity forms the first part of the alimentary canal.

→ It is surrounded by various muscles and bones which are as follows:

- **Anteriorly** : The anterior wall is bound by the lips.
- **Posteriorly** : The posterior wall continues with the oropharynx.
- **Laterally** : The lateral walls are bound by the cheek muscles.
- **Superiorly** : The superior wall is bound by the bony hard palate and muscular soft palate.
- **Inferiorly** : The inferior wall is bound by the muscular tongue and the soft tissues of the floor of mouth

Anatomy

- The roof of oral cavity is formed by the palate.
- The anterior part is referred to as the hard palate.
- while the posterior part forms the soft palate.
- The maxilla and palatine bones form the hard palate.
- The posterior end of the hard palate is continuous with the muscular soft palate.
- which curves downwards merging with the pharyngeal walls on both the sides



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Functions

- ✓ Ingestion of food,
- ✓ Perception of taste of food,
- ✓ Lubrication of food,
- ✓ Mechanical digestion of food with the help of salivary enzymes,
- ✓ Aids in speech, and
- ✓ Acts as a source for delivery of drugs.

Teeth

- As soon as the food is taken in the mouth, it is chewed with the help of teeth to breakdown into smaller particles.
- This process is known as mastication.
- Teeth are hard calcified structures that help in mastication, and thus aid in the process of mechanical digestion.
- Teeth can functionally be divided into two broad categories, viz., the deciduous teeth (baby or milk teeth; 20 in number) and the permanent teeth (adult teeth; 32 in number).
- Deciduous teeth are replaced with permanent teeth in around 6-7 years of age

Anatomy

- The basic structure of a tooth includes a crown (the visible part) and a root (the part within the gum, holding the tooth firmly).
- The crown is covered with enamel (a highly mineralised tissue) and the root is covered with cementum (hard connective tissue).
- The part connecting the crown and the root portion of a tooth is referred to as the neck.
- Crown consists of enamel and dentin.
- Enamel is the hardest and the most mineralised entity of the human body; it forms the outermost covering in a tooth.
- The major mineral present in it is calcium phosphate (in the form of hydroxyapatite).
- Dentin (a hard connective tissue just like bone) is the layer present beneath the enamel and accounts for the largest portion of the tooth.
- It surrounds the pulp (a soft connective tissue comprising of blood vessels and nerves innervating the tooth).
- The pulp tissue, dentin, and cementum cover the root from inside out.
- The root is held to the dental alveolus (bony socket) via periodontal ligament (specialised connective tissue fibres).

- The nerves and blood vessels present in the pulpal tissue enter and exit via apical foramen (opening at the apex of a tooth root).



Types and Functions

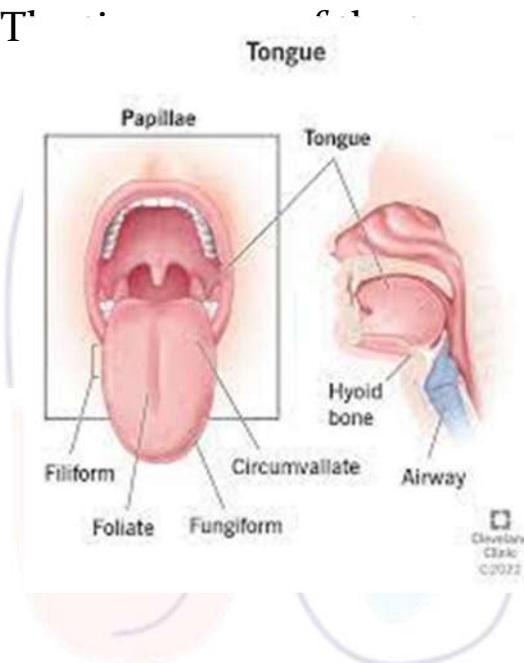
- ✓ **Incisors** : These teeth aid in biting-off large pieces of food.
- ✓ **Cuspids/Canines** : These conical-shaped teeth aid in grasping and tearing the food.
- ✓ **Bicuspid/Premolars** : These teeth help in grinding the food; they are absent in children (appear only after 9 years of age).
- ✓ **Molars** : These are the largest teeth and are present at the back of the mouth. They also aid in grinding the food.

Tongue

- Tongue is a muscular organ situated on the floor of the mouth , which helps in chewing and swallowing of food (deglutition).
- A large amount of nerve and blood vessels innervates the tongue there by helping in its movement.

Anatomy

- Tongue (derived from the Latin term lingua and Greek term glossa), is located at the floor of the mouth.
- It is attached to the hyoid bone, mandible, styloid processes, and pharynx via muscles.
- It consists of a tip (tongue tip), margin, dorsum, ventral (inferior) surface, and root. The tip of the tongue rests against the incisors.



Functions

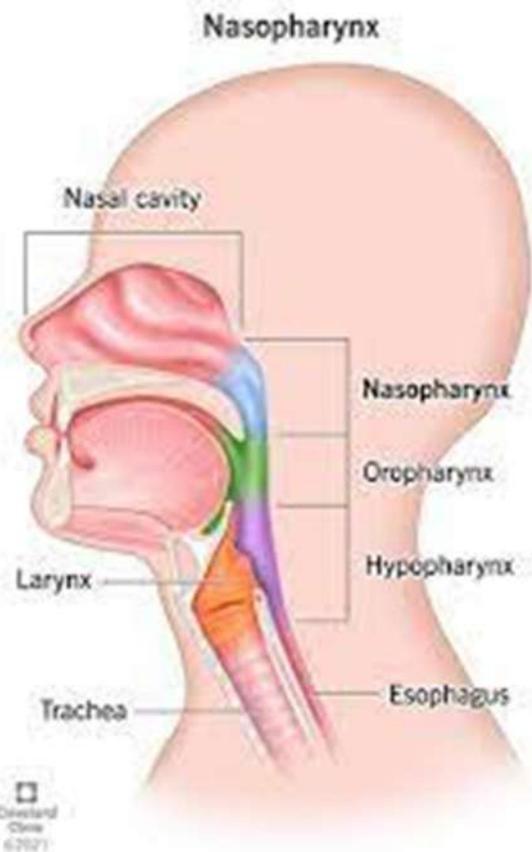
- ✓ Tongue houses various taste buds thus helps in Perception of the taste of food. The taste buds also help in sensing whether the food is noxious (harmful) or not.
- ✓ It plays a significant role in the digestive process. It helps in the movement of food within the oral cavity to be available for chewing and grinding.
- ✓ It also helps in the formation of bolus which is then swallowed.
- ✓ It also helps in speech and phonetics where it helps producing different sounds by altering the shape of the wind pipe and by repositioning the tongue. Thus, the vocal cords are able to produce sound.

Pharynx

→ Pharynx (throat) is a funnel-shaped tube extending from the internal nares to the posterior part of oesophagus and anterior part of larynx. Pharynx is made up of skeletal muscles, lined with mucous membrane and is divided into nasopharynx, oropharynx, and laryngopharynx

Anatomy

- In humans, the pharynx can be divided into three parts
- **Nasopharynx:** This part of the Pharynx lies immediately posterior to the nasal cavity. The postero-superior boundary of nasopharynx extends from the junction of the hard and soft palates till the base of the skull; the inferior boundary is formed by the superior surface of the soft palate and the lateral walls are formed by the fossa of rosenmuller.
- **Oropharynx:** This part of the pharynx lies immediately posterior to the oral cavity. The anterior wall of the oropharynx is formed by the base of the tongue and the vallecula (its depression) the superior boundary is marked by the junction between the hard and soft palates the inferior boundary begins posterior to the circumvallate papillae of the tongue and the lateral wall is made up of tonsil, tonsillar fossa, and tonsillar (faucial) pillars.
- **Hypopharynx or Laryngopharynx:** This part of the pharynx lies just inferior to the oropharynx and superior to the oesophagus. The name laryngopharynx corresponds to the levels of cervical vertebrae C₃ to C₆. It is bounded by the posterior pharyngeal wall and also includes the piriform sinus and the postcricoid mucosa. It is anteriorly bounded by the epiglottis and the larynx.



Functions

The functional activities of pharynx are :

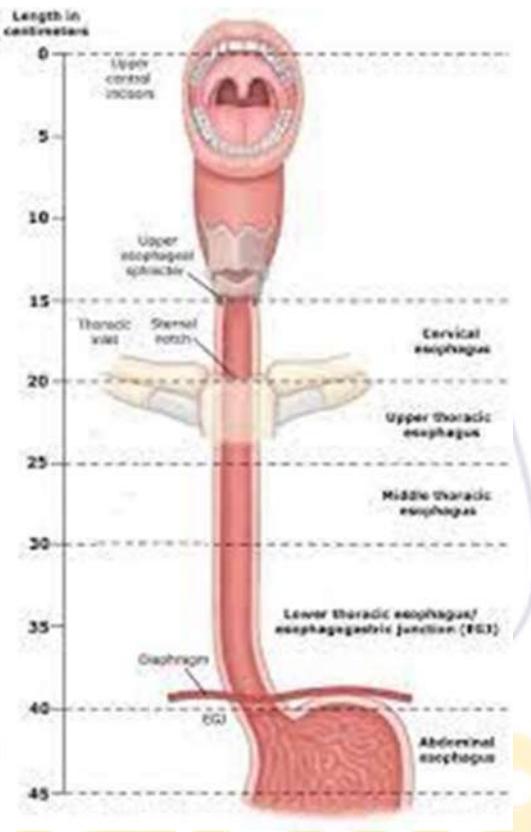
- ✓ Passageway for Air and food
- ✓ Taste
- ✓ Warming and Humidifying
- ✓ Hearing
- ✓ protection

Oesophagus

- Oesophagus or the food pipe is a long muscular tube (10 inches or 25cm long) which forms a passage for the food to pass from the pharynx to the stomach. It begins at the inferior end of the laryngopharynx, lies posterior to the trachea, and is anteriorly bounded by the trachea.
- The oesophagus continues from the hypopharynx at the level of C6 vertebra.
- When the food is swallowed, the oesophagus walls squeeze together (contract) to move the food down the oesophagus to the stomach.
- The upper part of oesophagus lies posteriorly but separate from the trachea or windpipe.
- The oesophagus joins the stomach at the gastro-oesophageal junction}

Anatomy

- **Mucosa** : Oesophagus is covered by mucosa.
- **Submucosa** : This layer lies beneath the mucosa and comprises of mucous- secreting glands (oesophageal glands) The connective structures present in this layer are known as papillae.
- **Muscularis Externa (or Muscularis Propria)** : This is the innermost layer lying beneath



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Functions

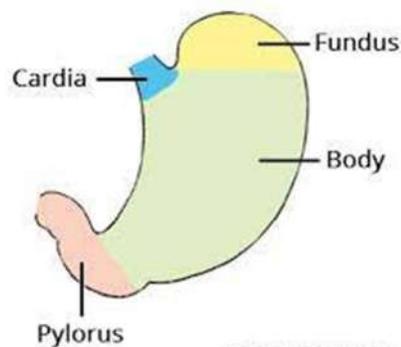
- ✓ Oesophagus mainly performs the function of deglutition (swallowing).
- ✓ This process is completed in three stages once the masticatory process is over and bolus has been formed.
- ✓ Though the initiation of deglutition is voluntary; however, its completion is by an involuntary (reflex) action

Stomach

- Stomach is a hollow, muscular, bag-like structure.
- It differs in size and shape in every individual from time to time, depending upon the contents present in the stomach.
- Body posture is another factor that alters its shape and size at any given moment of time.
- Stomach lies between the oesophagus and the small intestine.
- The second phase of digestion (after mastication) takes place in the stomach where the food (or bolus) is broken down into smaller components before being passed on to the remaining parts of the digestive system.

Anatomy

- Stomach is positioned on the left side of the abdominal cavity, between the oesophagus and the duodenum (uppermost part of the small intestine). Anatomically, stomach can be divided into four regions)
- Each region varies from the other in terms of cellular organisation and functions. They are:
 - ◆ **Cardia** : This part is continuous from the oesophagus.
 - ◆ **Fundus** : This dome-shaped part is formed by the upper curvature of the stomach.
 - ◆ **Body or Corpus** : This is the central region of the stomach.
 - ◆ **Pylorus or Antrum** : This is the lower region of the stomach that continues into the duodenum.



Functions

- Stomach performs the following functions :
- It provides highly acidic environment due to gastric acid production and secretion which produces a luminal pH range 1 to 3 depending on the species, food intake, time of the day, drug use, and other factors. Such an environment is able to breakdown large molecules (such as from food) into smaller ones so that they can eventually be absorbed from the small intestine.
- It secretes about 2-3 litres of gastric acid per day with basal secretion levels being typically highest in the evening.
- Pepsinogen is secreted by the chief cells of stomach wall and turns into pepsin under low pH conditions and is helpful in protein digestion.
- Absorption of vitamin B₁₂ from the small intestine is dependent on conjugation to a glycoprotein called intrinsic factor which is produced by the parietal cells of stomach.

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Acid Production in the Stomach

- The stomach plays a crucial role in digestion, especially in the breakdown of proteins.
- One of its most important functions is the production of hydrochloric acid (HCl), which helps maintain an acidic environment in the stomach.
- This process is tightly regulated by various cells, enzymes, and nervous/hormonal signals.

Site of Acid Production

- Parietal cells (also called oxyntic cells) located in the gastric glands of the fundus and body of the stomach are responsible for the production and secretion of hydrochloric acid (HCl).

Mechanism of HCl Secretion

- HCl is secreted into the lumen of the stomach through a complex process involving ion exchange:
- ❖ **Formation of H^+ Ions:**
 - Inside the parietal cell, carbon dioxide (CO_2) combines with water (H_2O) to form carbonic acid (H_2CO_3) via the enzyme carbonic anhydrase.
 - H_2CO_3 quickly dissociates into H^+ (hydrogen ions) and HCO_3^- (bicarbonate ions).
- ❖ **Proton Pump (H^+/K^+ -ATPase):**
 - The H^+ ions are secreted into the stomach lumen in exchange for K^+ ions using the H^+/K^+ -ATPase pump (proton pump) located in the apical membrane of the parietal cells.

❖ **Chloride Ion Movement:**

- Cl^- ions (chloride) are transported into the lumen by chloride channels.
- H^+ and Cl^- combine in the stomach lumen to form HCl (hydrochloric acid).

❖ **Bicarbonate Shift:**

- The HCO_3^- (bicarbonate) exits the parietal cell into the blood in exchange for Cl^- (chloride), a process called the alkaline tide, which makes the blood slightly alkaline after meals.

Regulation of Acid Production via Parasympathetic Nervous System

- The parasympathetic nervous system (PNS) plays a key role in regulating the secretion of hydrochloric acid (HCl) in the stomach.
- This regulation is primarily carried out through the vagus nerve, which stimulates acid secretion both directly and indirectly by influencing other cells involved in gastric function.

Parasympathetic System Stimulates Acid Secretion

- The parasympathetic nervous system stimulates acid production by acting on three main targets:

a. Direct Stimulation of Parietal Cells

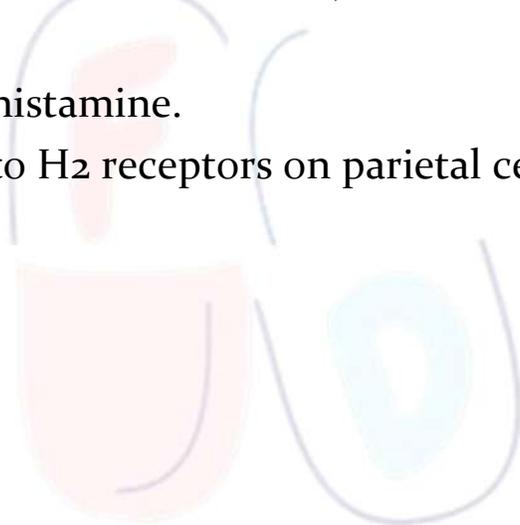
- The vagus nerve releases acetylcholine (ACh).
- ACh binds to M_3 muscarinic receptors on the parietal cells.
- This stimulates the H^+/K^+ ATPase pump (proton pump) → increases H^+ (acid) secretion into the stomach.

b. Stimulation of G Cells (Indirect Pathway)

- ACh also stimulates G cells in the antrum of the stomach.
- G cells secrete the hormone gastrin.
- Gastrin enters the bloodstream and stimulates parietal cells to produce more HCl.
- Gastrin also activates ECL cells (next point).

c. Stimulation of ECL (Enterochromaffin-like) Cells

- ACh and gastrin stimulate ECL cells, which are found near parietal cells.
- ECL cells release histamine.
- Histamine binds to H₂ receptors on parietal cells, further enhancing HCl secretion.



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Small Intestine

- Small intestine is a portion between the stomach and the large intestine.
- It is a long, highly convoluted tube in the digestive system that absorbs about 90% of the nutrients from the ingested food.
- It is the main site of absorption.
- Its internal wall is folded to form villi (finger-like tissues).
- Each of these villi is further covered with microvilli (even smaller finger-like projections).
- The presence of both villi and microvilli increase the surface area available for nutrients absorption
- Small intestine extends throughout the abdominal cavity inferior to the stomach.
- In adult humans, it measures about 7m in length (though it may vary from 4-7m) and 2.5-3cm in diameter.
- It is around 4-5 times longer than the large intestine, however, it is known that the diameter of small intestine is relatively smaller than that of the large intestine

Anatomy



Functions

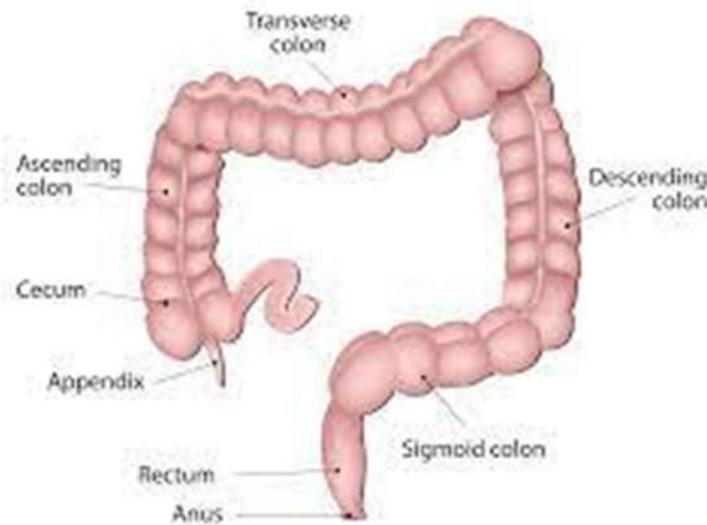
Small intestine performs the following functions:

- ✓ It forms a passage way for the movement of food into the large intestine by peristaltic movements.
- ✓ It receives the secretions of pancreas and liver to aid in digestion.
- ✓ The process of chemical digestion of carbohydrates, proteins, and fats is completed in the small intestine,
- ✓ It secretes two significant hormones, cholecystokinin (CCK) and secretin.
- ✓ It is the site for absorption of nutrients.
- ✓ The solitary lymph follicles and aggregated lymph follicles provide protection from microbes that survived the antimicrobial action of the hydrochloric acid produced in the stomach.

Large Intestine

- Large intestine forms the last part of the alimentary canal.
- It extends from the caecum to the anus, while including the ascending colon, transverse colon descending colon, sigmoid colon, and the rectum.
- It absorbs water and vitamins while converting the digested food into faeces.
- At the same time, it stores the waste matter before it is eliminated from the body.
- Large intestine wraps around the border of the abdominal body cavity from the right side of the body, across the top of the abdomen, and finally down the left side, In adult humans, it is about 1.5m in length, i.e., nearly one-fifth of the entire length of the intestine, and 6-7cm in diameter.
- Although shorter in length than the small intestine, large intestine is considerably thicker in diameter.

Anatomy



Functions

Large intestine performs the following functions:

- ✓ Secretions from the large intestine lubricate the faeces, facilitating their passage via rectum and the anus.
- ✓ It houses bacteria (e.g., *E. coli*, *S. faecalis*, and *C. welchii*) which act on different undigested and unabsorbed food material. These bacteria synthesise vitamin K and folic acid.
- ✓ It forms the site for absorption of water, glucose, and salt.
- ✓ Intestinal walls form the site for excretion of excess amounts of calcium, iron, and drugs of the heavy metals.
- ✓ Segmental contractions occur in the large intestine which helps in mixing of the matter inside the colon. On the other hand, the peristaltic contractions of large intestine push the matter towards the rectum, which is ultimately evacuated.
- ✓ The descending and sigmoid colon undergo mass action contractions, in which a large portion of the intestine contracts simultaneously, promoting defecation.

Salivary Glands

→ Three pairs of large multicellular salivary glands are present in the mouth:

1. **Parotid Glands** : These are paired and largest salivary gland. They are located immediately anterior to the ear on either sides and produces serous secretions. Secretion of these glands is released by the parotid duct which opens adjacent to the upper second molar in the oral cavity.
2. **Submandibular Glands** : These are second largest gland and are also paired. They are located below the mandible (thus the name submandibular). Secretion of these glands is mixed types. i.e., both serous and mucous secretions. Secretion of this gland is released via a submandibular duct which opens in the mandibular region of the oral cavity. adjacent to the frenulum of the tongue.
3. **Sublingual Glands** : These are the smallest and are also paired glands. These glands secrete mucous. These are ductless glands. Instead, each sublingual gland opens into the floor of the oral cavity through 10-12 small ducts.)

Anatomy



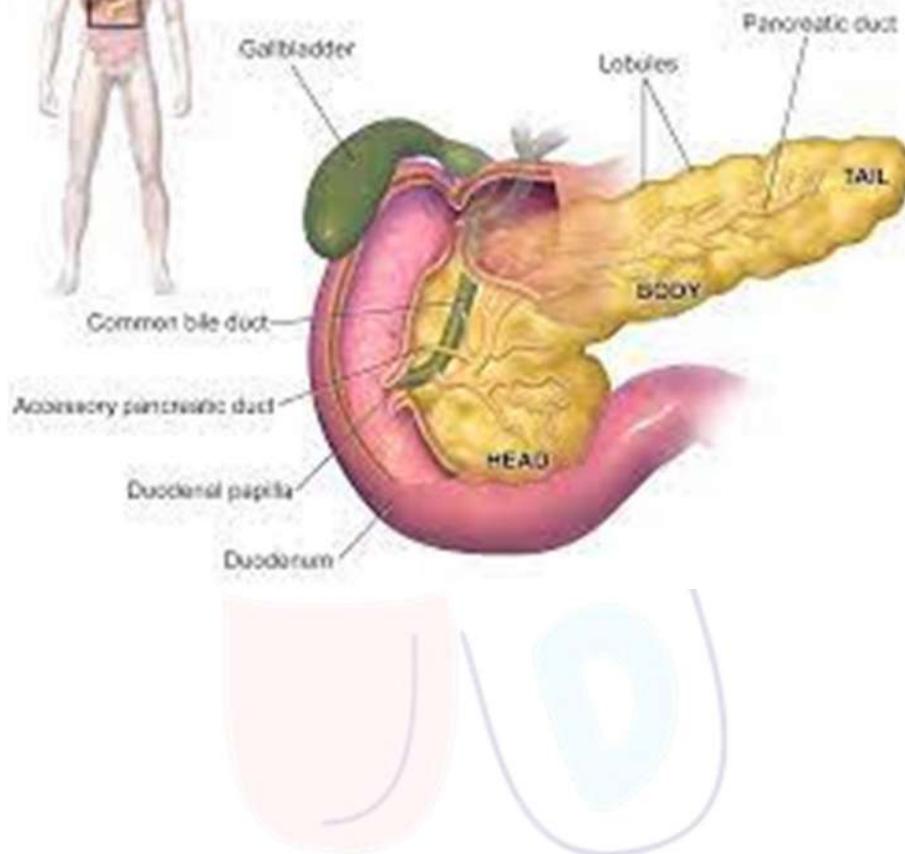
Functions of Saliva

- ✓ The rate of secretion of saliva is approximately 1- 1.5L/day.
- ✓ Salivary amylase, a component of serous salivary secretion, helps in the breakdown of carbohydrates.
- ✓ Mucin (a proteoglycan) is a component of mucous secretions of the submandibular and sublingual glands.
- ✓ Mucin is secreted in large amounts by these glands and is responsible for the lubricating property. Saliva has antibacterial properties due to the presence of substances like lysozyme and immunoglobulin A.

Pancreas

- Pancreas is an elongated, digestive gland: its size measures 6-10 inches and its weight is 65gm.
- It is spongy and shaped like a flat pear or a fish extended horizontally across the abdomen.
- It is located behind the stomach in the upper left abdomen, and close to the duodenum.
- It is the largest gland of the digestive system.
- It is formed by many lobules, and both exocrine and endocrine tissues.
- Pancreas plays an essential role in converting the ingested food into fuel for the body's cells.
- It is a mixed gland producing both exocrine (pancreatic juice containing digestive enzymes) and endocrine (insulin, glucagon, and somatostatin) secretions.

Anatomy



Functions

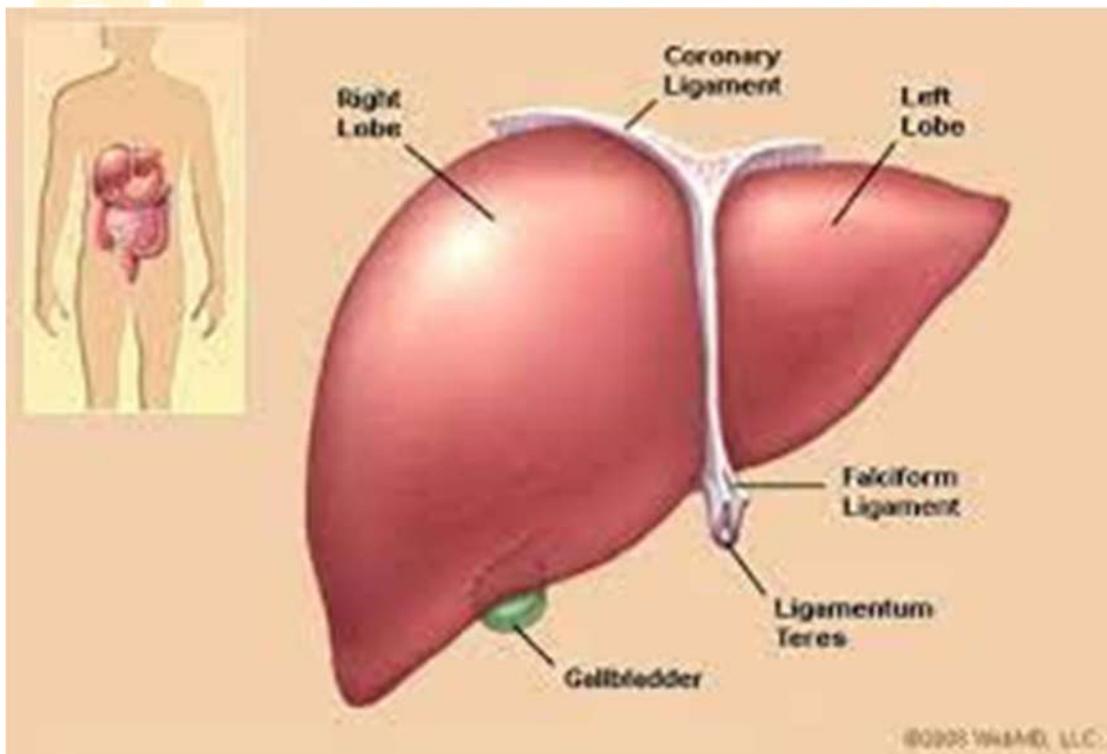
Functions of the pancreas are digestive and hormonal and can be explained as follows:

- ✓ **Exocrine Function** : The inactive enzymes of the pancreatic exocrine gland move down the pancreatic duct to reach the bile duct. These enzymes are activated only when they enter the duodenum. The carbohydrates, fats, proteins, and acids in the duodenum are broken down by these enzymes. A bicarbonate is also secreted by the exocrine tissue to neutralise the stomach acids in the duodenum.
- ✓ **Hormonal Function** : Insulin and glucagon are the main hormones secreted by the pancreatic endocrine gland. These hormones regulate the level of glucose and somatostatin in the blood.

Liver

- Liver is the largest gland of the human body.
- It forms the second largest organ (skin is the largest organ).
- It lies just inferior to the diaphragm in the right side of the abdomino thoracic region.
- It weighs about 1.4kg, is reddish-brown in colour, and feels rubbery when touched.
- Along with digestion, liver performs various other functions like (detoxification, protein synthesis, and production of chemicals (bile) used in digestion.
- It also filters the blood coming from the digestive tract, before passing it to the rest of the body.
- It detoxifies chemicals and metabolises the drugs.
- Meanwhile it also secretes bile that ends up back in the intestines.
- The liver also makes proteins essential for blood clotting and other functions.

Anatomy



Function

- ✓ Carbohydrates Metabolism
- ✓ Lipid Metabolism
- ✓ Protein Metabolism
- ✓ Processing of Drugs and hormones
- ✓ Extraction of bilirubin
- ✓ Synthesis of Bile salts
- ✓ Storage

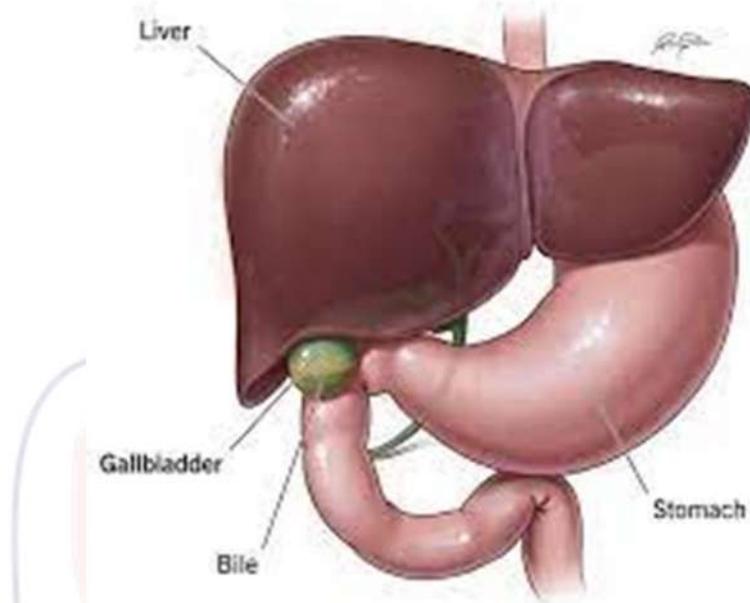
Gall Bladder

- Gall bladder is a pear-shaped organ present on the inferior surface of the liver on the right side of the abdomen.
- This membranous muscular sac like structure is nearly 8cm in length and 4cm in width
- After meals, the gall bladder becomes empty and flat (like a deflated balloon): while before meals, it is filled with bile and is about the size of a small pear.
- Gall bladder functions to store and concentrate bile, which is produced by the liver and helps in digestion process.
- It has a capacity of about 70ml.

Anatomy

- Gall bladder comprises of a fundus (broad part), the body, (central part), and the neck (narrow part).
- The body and neck extend superiorly.
- The fundus extends inferiorly away from the inferior border of the liver
- Wall of the gall bladder is lined by three layers of tissues:
 - An Inner mucosal layer which is folded into rugae. thus enabling expansion of the gall bladder,
 - A muscularis layer which is a layer of smooth muscles enabling contraction of the gall bladder, and

- An outer layer of serosa.



Functions

- ✓ Storehouse for Bile
- ✓ Anti-Oxidant
- ✓ Acid Neutralisation
- ✓ Emulsification of Lipids
- ✓ Facilitation of Absorption
- ✓ Elimination of Waste Products

Movements of the Gastrointestinal (GI) Tract

- The movements of the GI tract are essential for the proper digestion and absorption of food. These movements are controlled by the enteric nervous system, autonomic nervous system, and gastrointestinal hormones. They help in propelling food, mixing it with digestive juices, and absorbing nutrients.

Types of GI Movements

- There are two primary types of movements in the GI tract:

1. Propulsive Movements (Peristalsis)

- These movements push the contents of the GI tract forward.
- Occur throughout the esophagus, stomach, small intestine, and large intestine.

Peristalsis

- ▲ A wave-like contraction of the smooth muscle.
- ▲ Coordinated contraction of circular muscles behind the food bolus and relaxation ahead of it.
- ▲ Propels the contents forward.

Examples

- **Esophageal peristalsis:** Moves food from mouth to stomach.
- **Intestinal peristalsis:** Moves chyme from the small intestine to the large intestine.

2. Mixing Movements (Segmental Contractions)

- Do not propel the contents but help in mixing them with digestive secretions.
- Increase the contact of food with mucosa for better digestion and absorption.

Segmentation

- ▲ Localized rhythmic contractions of circular muscles in the small intestine.
- ▲ Divide and mix the chyme with digestive enzymes and bile.

Movements in Different Parts of the GI Tract

1. Esophagus

- + Primary peristalsis: Initiated by swallowing.
- + Secondary peristalsis: Initiated if food is stuck or not fully cleared.

2. Stomach

- + Receptive relaxation: Fundus and body relax to receive food.
- + Peristaltic waves: Begin at the mid-stomach and move toward the pylorus.
- + Retropulsion: Chyme is pushed back into the stomach for better mixing.

3. Small Intestine

- + Segmental contractions: Mix chyme with digestive juices.
- + Peristalsis: Moves chyme toward the ileocecal valve.
- + Migrating Motor Complex (MMC): Occurs during fasting to clear residual contents.

4. Large Intestine

- + Haustral churning: Slow segmentation that mixes fecal material.
- + Mass movements: Strong peristaltic contractions that move feces toward the rectum.
- + Occur 1–3 times a day, often after meals (gastrocolic reflex).

5. Rectum and Anus

- + Defecation reflex: Triggered by distension of rectum.
- + Voluntary and involuntary sphincter control involved in bowel movements.

Digestion and Absorption of Nutrients

Nutrient	Site of Digestion	Digestive Enzymes	End Products	Site of Absorption	Mechanism of Absorption
Carbohydrates	Mouth, small intestine	- Salivary amylase (mouth) - Pancreatic amylase - Brush border enzymes (maltase, sucrase, lactase)	Glucose, Fructose, Galactose	Jejunum and Ileum	- Glucose & Galactose: Active transport (SGLT-1) - Fructose: Facilitated diffusion (GLUT-5)
Proteins	Stomach, small intestine	- Pepsin (stomach) - Trypsin, chymotrypsin, carboxypeptidase (pancreas) - Peptidases (brush border)	Amino acids, dipeptides, tripeptides	Jejunum and Ileum	- Active transport - Co-transport with Na ⁺
Fats (Lipids)	Small intestine	- Lingual & gastric lipase - Pancreatic lipase - Bile salts (for emulsification)	Monoglycerides, free fatty acids	Jejunum	- Passive diffusion - Re-esterified into triglycerides and packed

					into chylomicrons for lymphatic absorption
Vitamins	Small intestine (depends on type)	- No digestion (except some coenzyme forms)	Free vitamins	Jejunum and Ileum	- Fat-soluble (A, D, E, K): With fats - Water-soluble (B-complex, C): Simple diffusion or active transport
Minerals	Stomach & small intestine	- HCl helps ionize minerals	Ionic forms (e.g., Fe^{2+} , Ca^{2+} , Na^{+})	Duodenum and Jejunum	- Active or passive transport (e.g., Ca^{2+} via vitamin D dependent mechanisms)
Water	Small and large intestine	- No enzymes	Water	Mainly large intestine	- Osmosis driven by solute absorption

DISORDERS OF THE GI TRACT

Gastroesophageal Reflux Disease (GERD)

→ A condition where stomach acid frequently flows back into the esophagus, irritating its lining.

- **Causes**

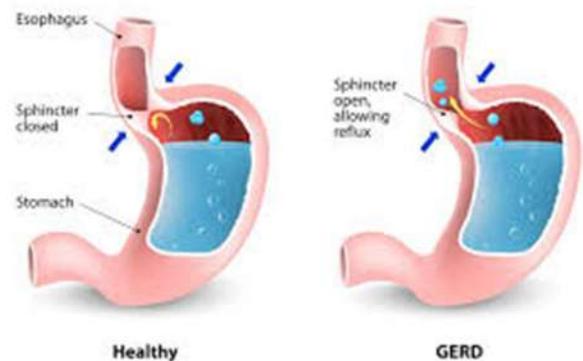
- Weak lower esophageal sphincter (LES)
- Obesity
- Spicy/fatty foods
- Smoking, alcohol, pregnancy

- **Symptoms**

- Heartburn
- Regurgitation
- Chest pain
- Difficulty swallowing

- **Treatment**

- Antacids, proton pump inhibitors (PPIs)
- Avoid trigger foods
- Elevate head while sleeping



Peptic Ulcer Disease (PUD)

→ Sores that develop on the lining of the stomach, duodenum, or esophagus.

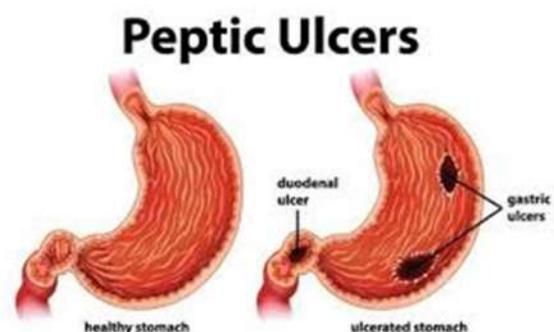
- **Causes**

- Helicobacter pylori infection
- NSAIDs (aspirin, ibuprofen)
- Stress and smoking

- **Symptoms**

- Burning stomach pain
- Bloating, nausea
- Black stools (if bleeding)

- **Treatment**



- Antibiotics for H. pylori
- PPIs, antacids
- Avoid NSAIDs and spicy foods

Gastritis

→ Inflammation of the stomach lining.

• Causes

- H. pylori infection
- Alcohol, smoking
- NSAIDs

• Symptoms

- Nausea, vomiting
- Loss of appetite
- Upper abdominal pain

• Treatment

- PPIs or H₂ blockers
- Avoid irritants
- Antibiotics (if H. pylori positive)



Constipation

→ Difficulty in passing stools or infrequent bowel movements.

• Causes

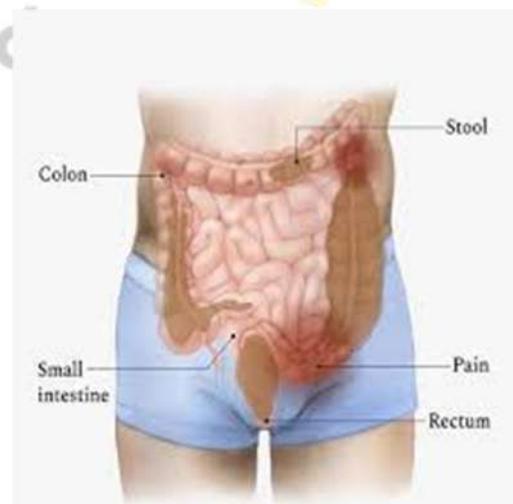
- Low fiber diet
- Dehydration
- Lack of physical activity

• Symptoms

- Hard, dry stools
- Abdominal discomfort
- Straining during bowel movement

• Treatment

- High-fiber diet, fluids
- Laxatives (short-term use)



Diarrhea

→ Frequent passage of loose or watery stools.

• Causes

- Bacterial/viral infections (e.g., E. coli, rotavirus)
- Food intolerance
- IBD or IBS

• Symptoms

- Loose stools
- Abdominal cramps
- Dehydration, weakness

• Treatment

- ORS (oral rehydration solution)
- Antibiotics (if bacterial)
- Dietary adjustments



Pharmacy
Learn and Educate