RESOURCES

Information, tables and figures of this lecture were taken from the following books:

**ATLAS OF HUMAN ANATOMY**
By Frank Netter

**ESSENTIAL OF HUMAN ANATOMY AND PHYSIOLOGY**
Elaine Marieb and Suzanne Keller

**GRAY’S ANATOMY**
By Richard Drake, Wayne Vogl & Adam Mitchell

**KENHUB WEBSITE**
www.kenhub.com
INTRODUCTION

- The **digestive system** (also called the alimentary or gastrointestinal system) consists of a series of hollow organs joined in a tube-like tract starting at the **mouth** and ending at the **anus**.
- So that it can be utilized as body fuel, the food and drink we consume must be broken down both physically and chemically into nutrients before they can be absorbed into the blood and carried to cells throughout the body.
- The body also must excrete waste.
- The organs of the digestive system collectively perform these activities.
- A properly functioning digestive system is essential for the effective interactions of almost all other body systems.
- A problem in the digestive system can cause conditions in other body systems and vice versa.
- This is why a healthy, well-balanced diet is important.

Khaleel Alyahya, PhD, MEd
FUNCTIONS

- The digestive system consists of a series of organs and glands that work together to **process** and **digest** food and to **excrete** wastes.
- Controlled by the intrinsic nervous system, digestion is a complex process of **motility**, **secretion** and **absorption**.
- *Intrinsic nervous system* is one of the main divisions of the autonomic nervous system (ANS) and consists of neurons that governs the function of the gastrointestinal tract.
- Most of the digestive system is made up of a long cylindrical tube (known as the alimentary canal or gastrointestinal tract) that moves the food from the mouth to the anus, plus accessory organs that assist with the chemical and mechanical breakdown of food.
- The gastrointestinal tract is approximately 9–10 meters in length and food takes between 12 and 48 hours to move from one end to the other.
There are seven basic processes that occur in the digestive system:

1. Ingestion This is an active, voluntary process of eating and drinking.
2. Propulsion moves the food along the digestive tract through a process called peristalsis, which is the rhythmic contraction and relaxation of the smooth muscle that lines the walls of the digestive organs. These muscular waves force the food down the alimentary canal.
3. Secretion of enzymes helps to process the food into liquid by adjusting the pH of the food and chemically breaking it down.
4. Mechanical digestion occurs when the food is physically broken down into smaller and smaller pieces. This process begins in the mouth as food is chewed to make it small enough to swallow and continues in the stomach and small intestine through the actions of their muscles.
5. Chemical digestion takes place as enzymes in the stomach and small intestine break down the food into simpler molecules.
6. Absorption occurs when these molecules move from the digestive tract to adjacent blood and lymphatic vessels for transport around the body.
7. Elimination occurs when undigested food is defecated from the body through the anus.
COMBINING FORMS

- Check page 225-226 from the book “Mastering Medical Terminology” for the complete list of combining form.

<table>
<thead>
<tr>
<th>Combining form</th>
<th>Meaning</th>
<th>Medical term</th>
<th>Meaning of medical term</th>
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<tbody>
<tr>
<td>abdomin/o</td>
<td>abdomen</td>
<td>abdomincentesis</td>
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<td>adhesio/o</td>
<td>adhesion</td>
<td>adhesiolyis</td>
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<tr>
<td>amyl/o</td>
<td>starch</td>
<td>amylase</td>
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<td>an/o</td>
<td>anus</td>
<td>anal stenosis</td>
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<td>appendic/o</td>
<td>appendix</td>
<td>appendicitis</td>
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<tr>
<td>bil/1</td>
<td>gall, bile</td>
<td>biliary cirrhosis</td>
<td></td>
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<tr>
<td>bilirubin/o</td>
<td>bile pigment</td>
<td>bilirubinuria</td>
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<tr>
<td>bucc/o</td>
<td>cheek</td>
<td>buccal surface</td>
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<td>caec/o</td>
<td>caecum</td>
<td>caecopexy</td>
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<td>cheil/o</td>
<td>lip</td>
<td>cheiloplasty</td>
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<tr>
<td>chol/e</td>
<td>gall, bile</td>
<td>cholesteatoma</td>
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<td>cholangi/o</td>
<td>bile duct</td>
<td>cholangiogram</td>
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<td>cholecyst/o</td>
<td>gallbladder</td>
<td>cholecystectomy</td>
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<td>choledoch/o</td>
<td>common bile duct</td>
<td>choledocholithiasis</td>
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<tr>
<td>cirrh/o</td>
<td>orange, yellow</td>
<td>hepatic cirrhosis</td>
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<td>coeli/o</td>
<td>abdomen</td>
<td>coeliac</td>
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<tr>
<td>col/o</td>
<td>colon, large intestine</td>
<td>colorectal</td>
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<tr>
<td>colon/o</td>
<td>colon</td>
<td>colonoscopy</td>
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<tr>
<td>cyst/o</td>
<td>bladder, cyst, sac</td>
<td>cholecystitics</td>
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</table>
# PREFIX & SUFFIX

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
<th>Medical term</th>
<th>Meaning of medical term</th>
</tr>
</thead>
<tbody>
<tr>
<td>dia-</td>
<td>through, across</td>
<td>diarrhoea</td>
<td></td>
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<tr>
<td>hemi-</td>
<td>half</td>
<td>hemigastrectomy</td>
<td></td>
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<tr>
<td>hyper-</td>
<td>above, excessive</td>
<td>hyperemesis</td>
<td></td>
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<tr>
<td>post-</td>
<td>after, behind</td>
<td>postprandial</td>
<td></td>
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<tr>
<td>sub-</td>
<td>under, below</td>
<td>sublingual</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Meaning</th>
<th>Medical term</th>
<th>Meaning of medical term</th>
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</thead>
<tbody>
<tr>
<td>-ase</td>
<td>enzyme</td>
<td>lipase</td>
<td></td>
</tr>
<tr>
<td>-chezia</td>
<td>defection, elimination of waste products</td>
<td>dyschezia</td>
<td></td>
</tr>
<tr>
<td>-emesis</td>
<td>vomiting</td>
<td>haematemesis</td>
<td></td>
</tr>
<tr>
<td>-iasis</td>
<td>abnormal condition or state</td>
<td>cholelihiasis</td>
<td></td>
</tr>
<tr>
<td>-pepsia</td>
<td>condition of digestion</td>
<td>dyspepsia</td>
<td></td>
</tr>
<tr>
<td>-prandial</td>
<td>meal</td>
<td>preprandial</td>
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</tbody>
</table>
PRONUNCIATION

Check page 227-228 from the book “Mastering Medical Terminology” for the complete list of pronunciation.
ABBREVIATIONS

Check page 228 from the book “Mastering Medical Terminology” for the complete list of abbreviations.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Ba</td>
<td>barium</td>
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<tr>
<td>BMI</td>
<td>body mass index</td>
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<tr>
<td>ERCP</td>
<td>endoscopic retrograde cholangiopancreatography</td>
</tr>
<tr>
<td>GI(T)</td>
<td>gastrointestinal (tract)</td>
</tr>
<tr>
<td>GORD</td>
<td>gastro-oesophageal reflux disease</td>
</tr>
<tr>
<td>IBD</td>
<td>inflammatory bowel disease</td>
</tr>
<tr>
<td>IBS</td>
<td>irritable bowel syndrome</td>
</tr>
<tr>
<td>LFTs</td>
<td>liver function tests</td>
</tr>
<tr>
<td>N&amp;V</td>
<td>nausea and vomiting</td>
</tr>
<tr>
<td>NG</td>
<td>nasogastric</td>
</tr>
<tr>
<td>NPO, NBM</td>
<td>nil per os, nil by mouth</td>
</tr>
<tr>
<td>NSAID(s)</td>
<td>non-steroidal anti-inflammatory drug(s)</td>
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<tr>
<td>OGD</td>
<td>oesophagogastroduodenoscopy</td>
</tr>
<tr>
<td>PEG tube</td>
<td>percutaneous endoscopic gastrostomy tube</td>
</tr>
<tr>
<td>PEJ tube</td>
<td>percutaneous endoscopic jejunostomy tube</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR</td>
<td>per rectum, by way of the rectum</td>
</tr>
<tr>
<td>PTHC</td>
<td>percutaneous transhepatic cholangiography</td>
</tr>
<tr>
<td>PUD</td>
<td>peptic ulcer disease</td>
</tr>
<tr>
<td>TPN</td>
<td>total parenteral nutrition</td>
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</tbody>
</table>
DIGESTIVE ORGANS

- The digestive organs consists of the following organs:
  - **Upper Gastrointestinal Tract**
    - Mouth
    - Salivary Glands
    - Tongue and Teeth
    - Pharynx
    - Esophagus
    - Stomach
  - **Lower Gastrointestinal Tract**
    - Small Intestine
    - Large Intestine
    - Rectum
    - Anus
  - **Accessory Organs**
    - Liver
    - Pancreas
    - Gallbladder
The digestive process begins before food is placed in the mouth, as the senses (such as smell) identify the presence of food and alert the other digestive organs to produce various gastric juices in preparation for digestion.

The salivary glands in the mouth produce saliva which mixes with the food, acting as a lubricant and killing some of the microorganism's present.

The major salivary glands are:
- Parotid
- Submandibular
- Sublingual

The saliva also contains amylase, an enzyme which begins the chemical process to break starches down into sugars.
TONGUE & TEATH

- The teeth have a mechanical function, crushing, grinding and tearing the food into a size and consistency suitable for swallowing.

- There are two types of teeth — incisors at the front of the mouth, which cut and tear food, and the molars, located in the middle and back of the mouth, which act to crush and grind the food.

- A band of muscle, known as the tongue, is covered with mucous membrane and contains papillae.

- In between these small bumps are the taste buds — sweet, sour, salty, savoury (umami) and bitter tastes are identified by different parts of the tongue.

- The decision to swallow starts as a voluntary movement, but once swallowing begins the process becomes involuntary, and is controlled by the nervous system.

- The ball of food, once swallowed, is known as a bolus.
PHARYNX

- The pharynx is the part of the throat that lies directly behind the mouth.
- The pharynx is divided into three parts known as the nasopharynx, oropharynx and laryngopharynx.
- The nasopharynx lies behind the nose and above the soft palate.
- The mouth leads into the oropharynx.
- The walls of the oropharynx are lined with mucous membrane that has adapted to handling food as well as air.
- It is here that the two types of tonsils are located.
- The human palatine tonsils and the nasopharyngeal tonsils are both made up of lymphoepithelial tissues and are believed to have a role in defending the body against inhaled or swallowed pathogens.
- The laryngopharynx is the common pathway for both air and food and connects to the esophagus.
ESOPHAGUS

- The **bolus** of food is directed by the pharynx into the esophagus where waves of **peristalsis** move it down to the stomach.

- The entrance to the stomach is guarded by the **gastro-esophageal sphincter** (also called the **cardiac sphincter**), a ring-like valve which detects the approach of the bolus, relaxes and opens to allow it into the stomach.

- The sphincter then closes, helping to ensure that the food only moves in one direction.

- The esophagus located posteriorly to the following structures: trachea, left recurrent laryngeal nerve, left principal bronchus, pericardium and left atrium.

- While it located anteriorly to the following structures: bodies of the thoracic vertebrae, thoracic duct, azygos veins, right posterior intercostal arteries and descending thoracic aorta.
STOMACH

- The stomach undertakes three mechanical processes — it stores the food and liquid in its upper part or fundus, mixes them up with various digestive juices through the muscular action of the middle-lower stomach or corpus, and moves the resultant partially digested mixture into the small intestine through pylorus.

- In addition to these mechanical actions, the stomach also has chemical digestive processes which are triggered by the release of gastrin, a hormone, in the blood.

- Various types of gastric juices are produced by the stomach — proteases (such as pepsin), mucus and hydrochloric acid.

- In humans, gastric juices are very acidic and help the process of breaking down the food into chyme, a liquid.

- The high acidity level also helps with killing microorganisms.

- An empty adult stomach has a volume of about 45 mL but can expand to hold as much as 3 L, although a normally full stomach is about 1 L in volume.
STRUCTURES OF STOMACH

- Stomach has a C-Shaped with 25cm long.
- It is a dilated part of the alimentary canal.
- Much of the stomach is protected by the lower ribs.
- Located between the esophagus and the small intestine, and it is hidden by liver & diaphragm.

- Parts of stomach include:
  - Cardiac region
  - Fundus
  - Body
  - Pylorus

- Borders of stomach include:
  - Lesser & Greater curvatures

- Surfaces of stomach include:
  - Anterior & Posterior

- Two sphincters keep the contents of the stomach contained.
  - The lower esophageal sphincter (found in the cardiac region), at the junction of the esophagus and stomach.
  - The pyloric sphincter at the junction of the stomach with the duodenum.
SMALL INTESTINE

- The small intestine, consisting of the **duodenum**, **jejunum** and **ileum**, is the longest part of the intestinal tract, being around 6 m in length.
- As the chyme moves through the pyloric sphincter, it enters the first part of the small intestine, the **duodenum**.
- This is where **alkalis** neutralize the acids from the stomach.
- **Bile** from the gallbladder and **enzymes** from the pancreas enter the duodenum through ducts and mix with mucus to coat the chyme.
- The **majority of proteins**, **carbohydrates** and **fats** are absorbed into the bloodstream in the duodenum.
- The second part of the small intestine is the **jejunum**.
- Through its villi (finger-like projections), it absorbs more **carbohydrates** and **proteins** which then enter the bloodstream.
- The jejunum directs the remainder of the material into the distal part of the small intestine, known as the ileum.
- The **ileum** absorbs **vitamin B12** and **bile salts** as well as any remaining nutrients.
- Peristaltic waves then move waste products through the **ileocaecal** valve into the large intestine.
The large intestine consists of the **caecum**, **colon** and **rectum**.

Altogether, the large intestine is only about 1 m in length but is 4 cm wide, the width giving it the name large intestine.

The **caecum** is basically a holding bay between the small intestine and the remainder of the large intestine.

It is also attached to the **appendix**, a blind-ended structure the principal purpose of which is unknown.

- It has been suggested that the appendix previously had a role in the **immune system** but that natural selection has changed its purpose.

The middle portion of the large intestine is called the **colon** and has four parts — the **ascending**, **transverse**, **descending** and **sigmoid** colon.

As it moves through these parts, **salts**, **residual vitamins**, **minerals** and **water** are extracted from the remainder of the ingested materials.

What is left is now considered **waste product**.

This product mixes with mucus and bacteria to become **faeces**.

In the sigmoid colon, the walls retract forcing the faeces into the rectum where it is stored.
The anus is a sphincter that relaxes to allow the feces stored in the rectum to be released to the external environment. This process is known as defecation.
LIVER

- The liver has a vital role in helping the body to remove toxins, process nutrients and regulate metabolism.
- It is located on the upper right-hand side of the abdominal cavity and is the second largest organ in the body after the skin.
- All blood containing nutrients obtained in the digestive system is filtered through the liver prior to being transported around to the rest of the body.
- The liver detoxifies chemicals and noxious materials and further breaks down nutrients into more manageable products.
- The liver creates bile which is then stored in the gallbladder before being used to break down fats in the digestive process in the duodenum.
- It also stores vitamin B12, iron and copper and makes cholesterol and other fats.
- Glucose is made by the liver and is also obtained from the small intestine.
- The liver stores this as glycogen until it is needed by the body during exercise.
- At this time, the glycogen is converted into glucose and transported via the bloodstream to the muscles to use as energy.
LOCATION OF LIVER

▪ It is an accessory organ of the gastrointestinal located in the right upper quadrant of the abdomen.
▪ The largest visceral structure in the abdominal cavity.
▪ Its posteroinferior (visceral) surface lies in contact with the esophagus, the stomach, the duodenum, the right colic flexure, right kidney, suprarenal gland, and the gallbladder.
▪ It is completely surrounded by fibrous capsule and partially covered by peritoneum.
▪ Liver has an anterior relation with the following structures:
  - Diaphragm
  - Right and left costal margins
  - Lower margins of both lungs
  - Anterior abdominal wall at subcostal angle
▪ And it has a posterior relation with the following structures:
  - Diaphragm
  - Right kidney
  - Hepatic flexure of colon
  - Duodenum
  - Gallbladder
  - IVC
  - Esophagus
  - Stomach fundus
▪ The liver is divided by falciform ligament into:
  - Large right lobe
  - Small left lobe
The gallbladder is a pear-shaped organ connected to the liver and duodenum via the hepatic duct and the common bile duct.

The primary function is to store the bile created by the liver and make it more concentrated.

Bile is used by the small intestine to digest fats and neutralize some acids so that they are easier to digest.
PANCREAS

- The pancreas is a small glandular organ located behind the stomach and attached to the duodenum via the pancreatic duct.
- It has two major functions and is considered both an endocrine and exocrine gland.
- Its exocrine function is to produce digestive enzymes which pass through the pancreatic duct into the small intestine to help in the breaking down of fats, carbohydrates and proteins and in the neutralization of stomach acids.
- The important endocrine function of the pancreas is the production of insulin which regulates the levels of sugars in the blood.
- Insulin is produced by the islets of Langerhans, a small clump of cells in the pancreas.
- The pancreas also produces glucagon which helps with blood sugar regulation.
- It divided to head, neck, body and tail.
ACTIVITIES
FOOD GROUPS

- Because each of the major food groups has very different building blocks, let’s take a little time to review these organic molecules.
- The building blocks, or units, of carbohydrate foods are simple sugars.
- We need to remember only three of these that are common in our diet: glucose, fructose, and galactose.
- **Glucose** is by far the most important, and when we talk about blood sugar level, we are referring to glucose.
- **Fructose** is the most abundant sugar in fruits, and **galactose** is found in milk.
- The only carbohydrates that our digestive system digests, or breaks down to simple sugars, are sucrose, lactose, maltose, and starch.
- Sucrose, maltose, and lactose are referred to as double sugars, because each consists of two simple sugars linked together.
FOOD GROUPS

- **Starch** is a polysaccharide (literally, “many sugars”) formed by linking hundreds of glucose units.

- Although we eat foods containing other polysaccharides, such as cellulose, we do not have enzymes capable of breaking them down.

- The indigestible polysaccharides do not provide us with any nutrients, but they help move the foodstuffs along the gastrointestinal tract by providing bulk, or fiber, in our diet.

- Proteins are digested to their building blocks, which are amino acids.

- The intermediate product of protein digestion is polypeptides.

- When lipids (fats) are digested, they yield two different types of building blocks: fatty acids and an alcohol called glycerol.
FOOD GROUPS

- Some of these processes are the job of a single organ.
- For example, only the mouth ingests, and only the large intestine defecates.
- But most digestive system activities occur bit by bit as food is moved along the tract.
- Thus, in one sense, the digestive tract can be viewed as a “disassembly line” in which food is carried from one stage of its processing to the next and its nutrients are made available to the cells in the body along the way.

Throughout previous lectures, we have stressed the body’s drive to maintain a constant internal environment, particularly in terms of homeostasis of the blood, which comes into contact with all body cells.

The digestive system, however, creates an optimal environment for itself to function in the lumen (cavity) of the alimentary canal.

Conditions in that lumen are controlled so that digestive processes occur efficiently.
CARBOHYDRATE DIGESTION

Foodstuff
- Starch and disaccharides
  - Digestion of carbohydrates
- Oligosaccharides* and disaccharides
  - Lactose
  - Maltose
  - Sucrose
  - Galactose
  - Glucose
  - Fructose

Enzyme(s) and source
- Salivary amylase
- Pancreatic amylase
- Brush border enzymes in small intestine (dextrinase, glucoamylase, lactase, maltase, and sucrase)

Site of action
- Mouth
- Small intestine
- Small intestine

Absorption of carbohydrates
The monosaccharides glucose, galactose, and fructose enter the capillary blood in the villi and are transported to the liver via the hepatic portal vein.
PROTEIN DIGESTION

1. **Digestion of proteins**
   - Protein
     - Large polypeptides
       - Pepsin (stomach glands) in the presence of HCl
     - Small polypeptides
       - Pancreatic enzymes (trypsin, chymotrypsin, carboxypeptidase)
       - Brush border enzymes (aminopeptidase, carboxypeptidase, and dipeptidase)

2. **Absorption of proteins**
   - Amino acids enter the capillary blood in the villi and are transported to the liver via the hepatic portal vein.
FAT DIGESTION

**Digestion of fats**
- Unemulsified fats
  - Monoglycerides and fatty acids
  - Glycerol and fatty acids
  - Emulsified by the detergent action of bile salts from the liver
  - Pancreatic lipase
  - Small intestine

**Absorption of fats**
- Fatty acids and monoglycerides enter the lacteals of the villi and are transported to the systemic circulation via the lymph in the thoracic duct. (Glycerol and short-chain fatty acids are absorbed into the capillary blood in the villi and transported to the liver via the hepatic portal vein.)
AUTONOMIC NERVOUS SYSTEM

- Digestive activity is mostly controlled by reflexes via the parasympathetic division of the autonomic nervous system.

- The sensors (mechanoreceptors and chemoreceptors) involved in these reflexes are located in the walls of the alimentary canal organs and respond to a number of stimuli, the most important being stretch of the organ by food in its lumen, pH of the contents, and presence of certain breakdown products of digestion.

- When these receptors are activated, they trigger reflexes that activate or inhibit:
  - The glands that secrete digestive juices into the lumen or hormones into the blood.
  - The smooth muscles of the muscularis that mix and propel the food along the tract.
ACTIVITIES

MOUTH, PHARYNX AND ESOPHAGUS
Once food has been placed in the mouth, both mechanical and digestive (chemical) processing begins.

First the food is physically broken down into smaller particles by chewing.

Then, as the food is mixed with saliva, salivary amylase begins the digestion of starch, chemically breaking it down into maltose.

The next time you eat a piece of bread, chew it for a few minutes before swallowing it.

You will notice that it begins to taste sweet as the sugars are released.

Saliva is normally secreted continuously to keep the mouth moist, but when food enters the mouth, much larger amounts of saliva pour out.

However, the simple pressure of anything put in the mouth and chewed, such as rubber bands or sugarless gum, will also stimulate the release of saliva.
Some emotional stimuli can also cause salivation.

For example, the more thought of a hot fudge sundae will make many a mouth water.

All these reflexes, though initiated by different stimuli, are brought about by parasympathetic fibers in cranial nerves VII and IX.

Essentially no food absorption occurs in the mouth. (However, some drugs, such as nitroglycerine, are absorbed easily through the oral mucosa.)

The pharynx and esophagus have no digestive function; they simply provide passage-ways to carry food to the next processing site, the stomach.

For food to be sent on its way from the mouth, it must first be swallowed.

Deglutition, or swallowing, is a complex process that involves the coordinated activity of several structures (tongue, soft palate, pharynx, and esophagus).
PHASES

- It has two major phases, the **buccal** and the **pharyngeal-esophageal**.
- **The first phase**, the *voluntary* buccal phase, occurs in the mouth.
- Once the food has been chewed and well mixed with saliva, the bolus (food mass) is forced into the pharynx by the tongue.
- As food enters the pharynx, it passes out of our control and into the realm of reflex activity.
- **The second phase**, the *involuntary* pharyngeal-esophageal phase, transports food through the pharynx and esophagus.
- The parasympathetic division of the autonomic nervous system (primarily the **vagus nerve**) controls this phase and promotes the mobility of the digestive organs from this point on.
- All routes that the food might take, except the desired route further into the digestive tract, are blocked off.
- The tongue blocks off the mouth, and the soft palate closes off the nasal passages.
- The larynx rises so that its opening (into the respiratory passageways) is covered by the **epiglottis**.
Food is moved through the pharynx and then into the esophagus inferiorly by wavelike peristaltic contractions of their muscular walls—first the *longitudinal* muscles contract, and then the *circular* muscles contract.

If we try to talk or laugh while swallowing, we confuse our bodies with mixed messages, and as a result food may enter the respiratory passages.

This triggers still another protective reflex—*coughing*—during which air rushes upward from the lungs in an attempt to expel the food.

Once food reaches the distal end of the esophagus, it presses against the *cardioesophageal sphincter*, causing it to open, and the food enters the stomach.

The movement of food through the pharynx and esophagus is so automatic that a person can swallow, and food will reach the stomach even if he is standing on his head.

Gravity plays no part in the transport of food once it has left the mouth, which explains why *astronauts* in the zero gravity of outer space can still swallow and get nourishment.
ACTIVITIES

STOMACH
INTRODUCTION

- Secretion of gastric juice is regulated by both neural and hormonal factors.
- The sight, smell, and taste of food stimulate parasympathetic nervous system reflexes, which increase the secretion of gastric juice by the gastric (stomach) glands.
- In addition, the presence of food and a rising pH in the stomach stimulate the stomach cells to release the hormone gastrin.
- Gastrin induces the gastric glands to produce more of the protein-digesting enzymes (such as pepsinogen), mucus, and hydrochloric acid.
- Under normal conditions, 2 to 3 liters of gastric juice are produced every day.
- Hydrochloric acid makes the stomach contents very acidic.
- This can be dangerous because both hydrochloric acid and the protein-digesting enzymes have the ability to digest the stomach itself, causing ulcers.
- However, as long as enough mucus is made, the stomach is protected.
FOOD BREAKDOWN

- The extremely acidic environment that hydro-chloric acid provides is necessary, because it activates pepsinogen to pepsin, the active protein-digesting enzyme.
- **Rennin**, the second protein-digesting enzyme produced by the stomach, works primarily on milk protein and converts it to a substance that looks like sour milk.
- Many parents mistakenly think that the curdy substance infants spit up after feeding is milk that has soured in their stomach.
- Rennin, produced in large amounts in infants, is the same enzyme used to make milk curdle into cheese.
- It is not believed to be produced in adults.
- Other than the beginning of protein digestion, little chemical digestion occurs in the stomach.
- Except for aspirin and alcohol (which seem somehow to have a special pass), virtually no absorption occurs through the stomach walls.
MUSCLES

- As food enters and fills the stomach, its wall begins to stretch (at the same time the gastric juices are being secreted, as just described).
- Then the three muscle layers of the stomach wall become active.
- They compress and pummel the food, breaking it apart physically, all the while continuously mixing the food with the enzyme-containing gastric juice so that the thick fluid chyme is formed.
- The process looks something like the preparation of a cake mix, in which the floury mixture is repeatedly folded on itself and mixed with the liquid until it reaches a uniform texture.
PYLORIC SPHINCTER

- Once the food has been well mixed, a rippling peristalsis begins in the upper half of the stomach.
- The contractions increase in force as the food approaches the pyloric valve, grinding the food into chyme.
- The pylorus of the stomach, which holds about 30 ml of chyme, acts like a meter that allows only liquids and very small particles to pass through the pyloric sphincter.
- Because the pyloric sphincter barely opens, each contraction of the stomach muscle squirts 3 ml or less of chyme into the small intestine.
- The contraction also closes the valve, so the rest of the chyme (about 27 ml) is propelled backward into the stomach for more mixing, a process called retropulsion.
- When the duodenum is filled with chyme and its wall is stretched, a nervous reflex, the entero-gastric reflex, occurs.
- This reflex “puts the brakes on” gastric activity.
- It slows the emptying of the stomach by inhibiting the vagus nerve and tightening the pyloric sphincter, thus allowing time for intestinal processing to catch up.
- Generally, it takes about 4 hours for the stomach to empty completely after the person eats a well-balanced meal and 6 hours or more if the meal has a high fat content.
ACTIVITIES
SMALL INTESTINE
INTRODUCTION

- Chyme reaching the small intestine is only partially digested.
- **Carbohydrate** and **protein** digestion has begun, but virtually no **fats** or **nucleic acids** have been digested up to this point.
- Here the process of chemical digestion is accelerated as the food now takes a rather wild 3- to 6-hour journey through the looping coils and twists of the small intestine.
- By the time the food reaches the end of the small intestine, digestion will be completed, and nearly all food absorption will have occurred.
- As mentioned earlier, the **microvilli** of small intestine cells bear several important enzymes, the so-called **brush border enzymes**, that break down double sugars into simple sugars and complete protein digestion.
- Intestinal juice itself is relatively enzyme poor, and protective mucus is probably the most important intestinal gland secretion.
PANCREATIC JUICE

- However, foods entering the small intestine are literally deluged with enzyme-rich **pancreatic juice** delivered via a duct from the pancreas, as well as **bile** from the liver.

- **Pancreatic juice** contains enzymes that (1) along with brush border enzymes, complete the digestion of starch (pancreatic amylase); (2) carry out about half of protein digestion (via the action of trypsin, chymotrypsin, carboxypeptidase, and others); (3) are totally responsible for fat digestion, because the pancreas is essentially the only source of lipases; and (4) digest nucleic acids (nucleases).

- In addition to enzymes, pancreatic juice contains a rich supply of **bicarbonate ions**, which makes it very basic (about pH 8).

- When pancreatic juice reaches the small intestine, it neutralizes the acidic chyme coming in from the stomach and provides the proper environment for activation and activity of intestinal and pancreatic digestive enzymes.
BILE SECRETION

- The release of pancreatic juice into the duodenum is stimulated by both the vagus nerve and hormones.
- When chyme enters the small intestine, it stimulates the mucosa cells to produce several hormones.
- Two of these hormones, secretin and cholecystokinin (CCK), influence the release of pancreatic juice and bile.
- The hormones enter the blood and circulate to their target organs, the pancreas, liver, and gallbladder.
- Both hormones work together to stimulate the pancreas to release its enzyme- and bicarbonate-rich product addition, secretin causes the liver to increase its output of bile, and cholecystokinin causes the gall-bladder to contract and release stored bile into the bile duct so that bile and pancreatic juice enter the small intestine together.
- As mentioned before, bile is not an enzyme. Instead, it acts like a detergent to emulsify, or mechanically separate large fat globules into thousands of tiny ones, providing a much greater surface area for the pancreatic lipases to work on.
- Bile is also necessary for absorption of fats and the fat-soluble vitamins (K, D, E, and A) that are absorbed along with them—from the intestinal tract.
ACTIVE AND PASSIVE TRANSPORTATION

- Absorption of water and of the end products of digestion occurs all along the length of the small intestine.
- Most substances are absorbed through the intestinal cell plasma membranes by the process of active transport.
- Then they enter the capillary beds in the villi to be transported in the blood to the liver via the hepatic portal vein.
- The exception seems to be lipids, or fats, which are absorbed passively by the process of diffusion.
- Lipid breakdown products enter both the capillary beds and the lacteals in the villi and are carried to the liver by both blood and lymphatic fluids.
- At the end of the ileum, all that remains is some water, indigestible food materials (plant fibers such as cellulose), and large amounts of bacteria.
- This debris enters the large intestine through the ileocecal valve.
CHYME PROPULSION

- As mentioned previously, **peristalsis** is the major means of propelling chyme through the digestive tract.

- It involves waves of contraction that move along the length of the intestine, followed by waves of relaxation.

- The net effect is that the food is moved through the small intestine in much the same way that toothpaste is squeezed from a tube.

- **Rhythmic** segmental movements produce local constrictions of the intestine that mix the chyme with the digestive juices and help to propel food through the intestine.
ACTIVITIES

LARGE INTESTINE
BREAKDOWN AND ABSORPTION

- What is finally delivered to the large intestine contains few nutrients, but that residue still has 12 to 24 hours more to spend there.

- The colon itself produces no digestive enzymes.

- However, the “resident” bacteria that live in its lumen metabolize some of the remaining nutrients, releasing gases (methane and hydrogen sulfide) that contribute to flatulence and the odor of feces.

- About 500 ml of gas (flatus) is produced each day, much more when certain carbohydrate-rich foods (such as beans) are eaten.

- Bacteria residing in the large intestine also make some vitamins (vitamin K and some B vitamins).

- Absorption by the large intestine is limited to the absorption of these vitamins, some ions, and most of the remaining water.

- Feces, the more or less solid product delivered to the rectum, contains undigested food residues, mucus, millions of bacteria, and just enough water to allow its smooth passage.
PROPULSION

- When presented with food residue, the colon begins contractions, but they are sluggish or short-lived.
- The movements most seen in the colon are haustral contractions, slow segmenting movements lasting about 1 minute that occur every 30 minutes or so.
- As a haustrum fills with food residue, the distension stimulates its muscle to contract, which propels the luminal contents into the next haustrum.
- These movements also mix the residue, which aids in water absorption.
- Mass movements are long, slow-moving but powerful contractile waves that move over large areas of the colon three or four times daily and force the contents toward the rectum.
- Typically, they occur during or just after eating, when food begins to fill the stomach and small intestine.
- Bulk, or fiber, in the diet increases the strength of colon contractions and softens the stool, allowing the colon to perform its function more effectively.
PROPULSION OF FOOD RESIDUE AND DEFECTION

- The rectum is generally empty, but when feces are forced into it by mass movements and its wall is stretched, the defecation reflex is initiated.

- The defecation reflex is a **spinal** (sacral region) reflex that causes the walls of the sigmoid colon and the rectum to contract and the anal sphincters to relax.

- As the feces are forced through the **anal canal**, messages reach the brain giving us time to decide whether the **external voluntary sphincter** should remain open or be constricted to stop passage of feces.

- If it is not convenient, **defecation** (bowel movement) can be delayed temporarily.

- Within a few seconds, the reflex contractions end, and the rectal walls relax.

- With the next mass movement, the defecation reflex is initiated again.
Check page 232-241 from the book "Mastering Medical Terminology" for the complete list of pathology and diseases.
DENTAL CARIES

- Dental caries is the medical term for the common condition of tooth decay.
- Bacteria in the mouth cause a film on the teeth called plaque.
- This in turn converts starches in food to acid.
- The acid erodes the enamel of the teeth causing caries.
- A high standard of oral hygiene is the best preventative measure.
STOMATITIS

- Stomatitis is an inflammation of the mucous membrane lining of the mouth including the cheeks, gums, lips, tongue and palate.
- It can be caused by injury such as burns from hot food or drinks, poorly fitting oral appliances, cheek biting, mouth breathing and poor oral hygiene.
Parotitis is an inflammation of one or both parotid glands.

- **Acute bacterial parotitis** results from a bacterial infection commonly occurring after radiation therapy or in immunocompromised patients.
- **Chronic parotitis** is recurrent bouts of infection in patients with a blocked or narrowed salivary duct.
- **Viral parotitis**, commonly called mumps, is caused by the paramyxovirus and causes a severe swelling of the parotid glands.
BARRETT’S OESOPHAGUS

- **Barrett’s oesophagus** is a pre-malignant condition in which the tissue lining the oesophagus is replaced by tissue that is similar to the lining of the intestine.

- The Barrett’s lining always begins at the bottom of the oesophagus and extends upward towards the mouth for varying distances.

- It is commonly found in people with gastro esophageal reflux disease (GORD).

- It can progress to adenocarcinoma of the oesophagus.
ESOPHAGEAL VARICES

- Esophageal varices are dilated (varicosed) veins in the lower part of the oesophagus or in the upper part of the stomach.
- They are associated with the increased venous pressure that occurs in liver diseases such as cirrhosis.
- Esophageal varices can rupture and cause extreme bleeding which may be life threatening.
GASTRIC CARCINOMA

- Gastric carcinoma is also called stomach cancer.
- Most gastric cancers are adenocarcinomas.
- The risk factors for developing stomach cancer are Helicobacter pylori (H. pylori) infection, cigarette smoking, excessive consumption of alcohol and a diet that is high in foods and beverages that contain nitrates and nitrites such as smoked and salted fish and meats and pickled vegetables.
- Symptoms may include anorexia, dysphagia, indigestion, bloating, nausea and haematemesis.
- Treatment for gastric cancer includes surgery, radiotherapy and chemotherapy.
GASTRITIS

- **Gastritis** is a condition in which there is an abnormal inflammation of the mucous lining of the stomach.
- Symptoms may include dyspepsia, nausea or vomiting.
- There are many causes of gastritis.
- One of the most common causes is infection by the bacteria *Helicobacter pylori*.
- Treating H. pylori infection is important as it may lead to gastric ulcer disease or cancer.
- Other causes of gastritis include prolonged use of alcohol or NSAIDs (Nonsteroidal anti-inflammatory drugs) such as aspirin, iron supplements and chemotherapy.

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GASTRIC ULCERS

- **Gastric ulcers** and duodenal ulcers are also known as peptic ulcers.
- They are erosions in the lining of the stomach or intestinal tract.
- Most peptic ulcers are caused by the bacterium *Helicobacter pylori* (H. pylori).
- Long term use of **NSAIDs**, such as aspirin and ibuprofen, is another common cause.
- Lifestyle factors, stress and diet used to be thought to cause ulcers, but recent research has shown that while these factors can worsen ulcers and prevent healing, they do not cause them.
- Peptic ulcers result in a **burning pain** in the stomach and duodenum.
- The pain may be temporarily relieved by eating food or by taking antacids.
- A combination of antibiotics and acid-reducing medication is the most effective treatment for H. pylori-induced peptic ulcers.

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Gastro-Esophageal Reflux Disease (GORD) is a form of chronic heartburn caused by the backflow (reflux) of acidic stomach contents into the oesophagus.

This is often due to incompetence of the cardiac sphincter between the stomach and oesophagus.

It results in a severe burning pain in the oesophagus and can lead to oesophagitis or ulceration.
CIRRHOSIS

- **Cirrhosis** is a chronic disease in which the liver slowly deteriorates, with scar tissue replacing healthy liver tissue and partially blocking the flow of blood through the liver.
- This reduced blood flow affects the way the liver performs its functions.
- Excessive alcohol consumption and chronic **hepatitis B** and **C** are the most common causes of cirrhosis.
- Other conditions such as fatty liver disease associated with obesity, blocked bile ducts and haemochromatosis also cause cirrhosis.
- **Cirrhosis** cannot be cured so treatment aims to prevent the disease from progressing.
- Treatment will include avoidance of alcohol and other drugs, nutrition therapy and medications to treat specific complications or causes of the disease.
- If the cirrhosis progresses and the liver fails, a liver transplant may be required.
HEPATITIS

- Hepatitis is an inflammation of the liver that can result in damage to the cells in the liver.
- It can lead to cirrhosis or cancer of the liver.
- Patients with hepatitis will have symptoms that include hepatomegaly, jaundice, clay-colored faeces, dark urine, abnormal liver function tests and generalised malaise.
- There are at least five viruses that cause different types of hepatitis.
- They are called hepatitis A, B, C, D and E.
- They all result in similar symptoms but differ in the way in which they are transmitted.
  - **Hepatitis A** is transmitted via ingestion of food or water that has been contaminated with infected feces.
  - **Hepatitis B** is transmitted by body fluids such as blood or semen.
  - **Hepatitis C** is transmitted by blood and blood products.
  - **Hepatitis D** has the same mode of transmission as hepatitis B.
  - **Hepatitis E** is also contracted by ingesting contaminated food or water.
TESTS & PROCEDURES
Check page 241-245 from the book “Mastering Medical Terminology” for the complete list of tests and procedures.
<table>
<thead>
<tr>
<th>Test/procedure</th>
<th>Pronunciation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>abdominal ultrasonography</td>
<td>ab-DOM-in-al ultra-son-OG-ra-fee</td>
<td>Abdominal ultrasonography is performed using high frequency sound waves to produce two-dimensional images of the abdominal cavity and its structures. It can be used as a diagnostic tool or as a method of guidance in other treatment procedures such as biopsies.</td>
</tr>
<tr>
<td>(ultrasound or sonography)</td>
<td>(UL-tra-sonnd or son-OG-ra-fee)</td>
<td></td>
</tr>
<tr>
<td>adhesiolysis</td>
<td>ad-heez-ee-o-LY-sis</td>
<td>Adhesiolysis is a procedure performed to separate or divide adhesions or scar tissue that may be causing an intestinal obstruction.</td>
</tr>
<tr>
<td>bariatric therapies</td>
<td>BA-ree-at-rk ther-a-pees</td>
<td>Bariatric medicine is a field of medicine focusing on the control and treatment of obesity and the diseases associated with obesity. Obesity can be treated in several ways. Diet, exercise or oral medications can be successful in some patients. However, in other patients, especially those who are morbidly obese, surgical interventions are required for weight reduction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Vagal blocking therapy</strong> delivers electrical impulses from a neuroregulator, via electrodes, to the vagus nerves, blocking the actions of the nerves. This results in a slower emptying of the stomach and an earlier feeling of fullness.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Intragastic balloon insertion</strong> is a reversible procedure involving the insertion of a soft, expandable silicone balloon into the stomach via endoscopy. The balloon is inflated using a sterile saline solution to create a feeling of fullness. The balloon is left in place for a period of up to 6 months.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Gastric banding</strong> involves the laparoscopic placement of a band around the top of the stomach, thus reducing the amount of food that can enter the stomach.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Gastric plication</strong> is a laparoscopic procedure which involves sewing one or more large folds in the stomach, reducing the stomach volume to approximately 70%. The procedure may be reversed or lead to other bariatric procedures.</td>
</tr>
<tr>
<td>Procedure</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
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<td></td>
</tr>
<tr>
<td>Sleeve gastrectomy</td>
<td>A non-reversible laparoscopic procedure. The outer part of the stomach is removed, resulting in the creation of a tube-like section in the upper part of the stomach. With a small portion of the stomach remaining, food intake capacity is reduced along with food absorption.</td>
<td></td>
</tr>
<tr>
<td>Gastro bypass surgery (e.g., Roux-en-Y gastric bypass)</td>
<td>A non-reversible procedure, commonly performed via laparoscopy. The stomach is divided into two sections, the upper and lower parts of the stomach. The upper section is then connected directly to the lower section of the small intestine, resulting in weight loss.</td>
<td></td>
</tr>
<tr>
<td>Biliopancreatic diversion</td>
<td>It is generally only performed on people with a BMI of 30 who have not been able to lose weight through other means, up to 70% of the stomach is removed and the remaining portion is connected to the lower portion of the small intestine. A less invasively version of this procedure is the biliopancreatic diversion with switch which involves connecting the stomach to the duodenum and not the lower part of the small intestine.</td>
<td></td>
</tr>
<tr>
<td>Capsule endoscopy</td>
<td>This form of endoscopic examination of the gastrointestinal tract uses a camera the size of a pill. The patient swallows the camera and images are taken throughout the GI tract, with the images being transmitted to a computer via Bluetooth technology. This procedure is particularly useful for diagnosis and treatment of diseases of the small intestine which are often difficult to identify through other endoscopic procedures.</td>
<td></td>
</tr>
<tr>
<td>Cholangiography</td>
<td>A diagnostic procedure that involves radiographic imaging of the bile ducts with contrast medium administered either via catheter or percutaneously.</td>
<td></td>
</tr>
<tr>
<td>Choledectomy</td>
<td>A surgical procedure for the removal of the gallbladder. The majority of choledectomies are now undertaken via laparoscopy.</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 13.11: Laparoscopic choledectomy**

Carbon dioxide is used to insufflate the surgical area for better visualization. A small incision is made in the flank of the umbilicus for the insertion of the laparoscope. Three additional small incisions are made for the insertion of operating sheaths to accommodate accessory instrumentation. (Adabour, 2022.)
<table>
<thead>
<tr>
<th>Test procedure</th>
<th>Preparation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>computed tomography (CT) scan of the abdomen</td>
<td>from IV contrast to MES than do-CT</td>
<td></td>
</tr>
<tr>
<td>examination</td>
<td>scan (CT-IV contrast: do-CT and MES)</td>
<td>A CT scan of the abdomen is a diagnostic test to identify injuries of the gastrointestinal tract. Cross-sectional images are taken using a computer in conjunction with a ray box.</td>
</tr>
<tr>
<td>enteroctomy</td>
<td>en-o-CT scan-ex</td>
<td>An enteroctomy is a procedure that involves the removal of the small or large intestine to allow for the insertion of a tube to make an artificial opening stoma for drainage or feeding purposes. The stoma can be temporary or permanent. Stomata are classified named according to the part of the intestine where the stoma has been created (e.g., ileostomy, colostomy, and duodenostomy).</td>
</tr>
<tr>
<td>enterotomy, ileostomy, colostomy, duodenostomy</td>
<td>en-o-CT scan-ex</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 11.32 Neostomy construction**

(From Schon et al. 2007)

| Fecal occult blood test (FOBT) (Chemiluminescence) | A test for occult blood in feces. This test is not suitable for examination, otherwise known as a fecal occult blood test. A guaiac test involves applying a few drops of a thick solution of paper coated with a film of guaiac in wood resin from a guaiacum test which reacts with the presence of blood. A FIT (fecal immunochemical test), sometimes called a HPR (immunochemical fecal occult blood test), is an increasingly common form of fecal occult blood test which gives improved results. |
|----------------------------------------------------|------------------------------------|------------------------------------------------------------------------------------------------|
| fecal culture                                       | FES-IX or ASC or Fireplas 115S    | The test also known as a cellular culture test for parasites or microbiota in feces. The test is undertaken when a patient has had diarrhea for several days or if they have blood or mucus in their feces. |
| fumoduplication                                     | Run-due-pH-RAF-dial                | Fundoplication is a surgical procedure that is undertaken to treat gastroesophageal reflux disease (GERD) or horse's head. It involves wrapping the fundus (upper part of the stomach, around the lower end of the esophagus and stomach in place, refilling the closing function of the lower esophageal sphincter. |
| gastrointestinal endoscopy                          | gas-top-in-SSZ-salt and 0.4% CO2   | This procedure involves use of an endoscope to view the gastrointestinal tract. The endoscope is inserted into the mouth or anus. The type of endoscope is inserted for the view of the gastrointestinal tract being reviewed, including gastroscopy, esophagogastroduodenoscopy, sigmoidoscopy, proctoscopy, esophagography, and esophagogram in duodenoscopy. These procedures are either diagnostic or allow access to parts of the gastrointestinal tract for biopsy or removal of lesions. |

<table>
<thead>
<tr>
<th>Table continued</th>
<th>protocol</th>
<th>Preparation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>computed tomography (CT) scan of the abdomen</td>
<td>from IV contrast to MES than do-CT</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>enterotomy, ileostomy, colostomy, duodenostomy</td>
<td>en-o-CT scan-ex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test/Procedure</td>
<td>Pronunciation</td>
<td>Definition</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
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<td></td>
</tr>
<tr>
<td>Liver scan</td>
<td>LIF-a-scán</td>
<td>A test scan is a diagnostic nuclear medicine procedure that uses a radioactive substance to diagnose various conditions, such as tumors, abscesses, hemorrhages, organ enlargement or cysts.</td>
<td></td>
</tr>
<tr>
<td>Upper ( \text{gastroesophageal reflux disease} ) (GERD) series</td>
<td>UPR-ga-sô-to-rf-de-ref-lus</td>
<td>A test series involves eating a barium meal, which coats the lining of the esophagus to highlight abnormalities more clearly on x-ray.</td>
<td></td>
</tr>
<tr>
<td>Magnetic resonance imaging ( \text{MRI} )</td>
<td>Me-RZ-ess-impl-ning</td>
<td>An MRI is a diagnostic test that creates images of the abdominal cavity using radio waves and a magnetic field to identify lesions that cannot be easily seen on x-ray.</td>
<td></td>
</tr>
<tr>
<td>Upper ( \text{gastroesophageal reflux disease} ) (GERD) series</td>
<td>UPR-ga-sô-to-rf-de-ref-lus</td>
<td>A test series involves eating a barium meal, which coats the lining of the esophagus to highlight abnormalities more clearly on x-ray.</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- PEG: A tube is placed by passing it through the mouth and into the stomach. The tube is used to inject contrast material. Initially, a small amount of contrast material is taken by the patient. After the tube is removed, a larger amount of contrast material is injected through the tube. The patient may experience some discomfort during the procedure.
- PEG: A tube is used to inject contrast material. Initially, a small amount of contrast material is taken by the patient. After the tube is removed, a larger amount of contrast material is injected through the tube. The patient may experience some discomfort during the procedure.
EXERCISES

Exercise 11.1: Label the Diagram

Using the information provided in this chapter, label the anatomical parts in the figures below.

---

Figure 11.1A
(Studying Anatomy, 2016)

Figure 11.1B
(Studying Anatomy, 2016)
<table>
<thead>
<tr>
<th>Meaning</th>
<th>Word Element</th>
<th>Medical term</th>
</tr>
</thead>
<tbody>
<tr>
<td>sinus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bile duct</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bile pigment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bladder, cont, sac</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cheek</td>
<td></td>
<td></td>
</tr>
<tr>
<td>definition, elimination of waste products</td>
<td></td>
<td></td>
</tr>
<tr>
<td>digestion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>eat, swallow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>enzyme</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>bile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>gall bladder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>limb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>meal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>orange/yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>small intestine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>starch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>through, across</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vomiting</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Exercise 11.3: Match Medical Terms and Meanings**

Match the medical term in Column A with its meaning in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. cholonecsectmy</td>
<td>A. breaking down of fat</td>
</tr>
<tr>
<td>2. sublingual</td>
<td>B. suture of a hernia</td>
</tr>
<tr>
<td>3. rectoanal</td>
<td>C. pertaining to the colon and rectum</td>
</tr>
<tr>
<td>4. capsulitis</td>
<td>D. fusion of the capsule</td>
</tr>
<tr>
<td>5. procaldynia</td>
<td>E. difficulty swallowing</td>
</tr>
<tr>
<td>6. transpyloric</td>
<td>F. surgical removal of the gall bladder</td>
</tr>
<tr>
<td>7. cholecystectomy</td>
<td>G. protein enzyme</td>
</tr>
<tr>
<td>8. ileus</td>
<td>H. pain in the rectum</td>
</tr>
<tr>
<td>9. paraplegia</td>
<td>I. drainage of fluid from the abdomen</td>
</tr>
<tr>
<td>10. vomitator</td>
<td>J. excessive vomiting</td>
</tr>
<tr>
<td>11. anorexia</td>
<td>K. pertaining to the mouth and gums</td>
</tr>
<tr>
<td>12. hemorragia</td>
<td>L. swelling of the stomach</td>
</tr>
<tr>
<td>13. colostomy</td>
<td>M. artificial opening of the intestine</td>
</tr>
<tr>
<td>14. dysphagia</td>
<td>N. pertaining to the tongue</td>
</tr>
<tr>
<td>15. stomatitis</td>
<td>O. difficult digestion</td>
</tr>
<tr>
<td>16. sigmoidoscopy</td>
<td>P. instrument to view the pharynx</td>
</tr>
<tr>
<td>17. pneumonitis</td>
<td>Q. inflammation of the pharynx and trachea</td>
</tr>
<tr>
<td>18. abdominocentesis</td>
<td>R. repair of the s<em>p</em></td>
</tr>
<tr>
<td>19. nectopeny</td>
<td>S. enlarged spleen</td>
</tr>
<tr>
<td>20. pyorranitols</td>
<td>T. inflammation of the mucous membrane of the mouth</td>
</tr>
</tbody>
</table>
Exercise 11.4: Spelling
Circle the correctly spelled medical term from the options provided.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Diarrhea</th>
<th>Diarrhea</th>
<th>Diarrhea</th>
<th>Diarrhea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemorrhoid</td>
<td>Hemorrhoid</td>
<td>Hemorrhoid</td>
<td>Hemorrhoid</td>
<td>Hemorrhoid</td>
</tr>
<tr>
<td>Cholecystitis</td>
<td>Cholecystitis</td>
<td>Cholecystitis</td>
<td>Cholecystitis</td>
<td>Cholecystitis</td>
</tr>
<tr>
<td>Intussusception</td>
<td>Intussusception</td>
<td>Intussusception</td>
<td>Intussusception</td>
<td>Intussusception</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>Pneumonia</td>
<td>Pneumonia</td>
<td>Pneumonia</td>
<td>Pneumonia</td>
</tr>
<tr>
<td>Polydipsia</td>
<td>Polydipsia</td>
<td>Polydipsia</td>
<td>Polydipsia</td>
<td>Polydipsia</td>
</tr>
<tr>
<td>Esophagoscopy</td>
<td>Esophagoscopy</td>
<td>Esophagoscopy</td>
<td>Esophagoscopy</td>
<td>Esophagoscopy</td>
</tr>
<tr>
<td>Diverticula</td>
<td>Diverticula</td>
<td>Diverticula</td>
<td>Diverticula</td>
<td>Diverticula</td>
</tr>
<tr>
<td>Cystitis</td>
<td>Cystitis</td>
<td>Cystitis</td>
<td>Cystitis</td>
<td>Cystitis</td>
</tr>
<tr>
<td>Glucose</td>
<td>Glucose</td>
<td>Glucose</td>
<td>Glucose</td>
<td>Glucose</td>
</tr>
</tbody>
</table>

Exercise 11.5: Expand the Abbreviations
Expand the abbreviations to form correct medical terms.

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Expanded Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/P</td>
<td>Blood Pressure</td>
</tr>
<tr>
<td>b.i.d.</td>
<td>Twice a day</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>EBCP</td>
<td>Endoscopic Biopsy</td>
</tr>
<tr>
<td>CDQD</td>
<td>Carbohydrate Digestion</td>
</tr>
<tr>
<td>IBD</td>
<td>Irritable Bowel Disease</td>
</tr>
<tr>
<td>IBS</td>
<td>Irritable Bowel Syndrome</td>
</tr>
<tr>
<td>LFTs</td>
<td>Liver Function Tests</td>
</tr>
<tr>
<td>N/V</td>
<td>Nausea/Vomiting</td>
</tr>
<tr>
<td>NG</td>
<td>Nasogastric</td>
</tr>
<tr>
<td>OGD</td>
<td>Oral Gastrointestinal</td>
</tr>
<tr>
<td>P/E hole</td>
<td>Rectal Examination</td>
</tr>
<tr>
<td>PTHC</td>
<td>Parathyroid Hormone</td>
</tr>
</tbody>
</table>
Exercise 11.6: Vocabulary Building
Provide the medical term for each of the definitions below.

1. Fused so that it has been broken down into a liquid.
2. An abnormal side pocket or pouch in the wall of the colon, usually related to a lack of fibre in the diet.
3. A tear or split in the lining of the anal canal due to minor trauma.
4. Hyperplasia, resulting in the smooth muscle that lines the walls of the digestive organs.
5. Gas in the gastrointestinal tract.
6. Dilated veins in the lower part of the oesophagus or in the upper part of the stomach.
7. A growth on the internal surface of the colon.
8. Movement of food along the digestive tract through a process called peristalsis.
9. Waxes with food to lubricate and to also kill microorganisms.
10. Release of faeces into the external environment.

Exercise 11.7: Pronunciation and Comprehension
Read the following paragraphs aloud to practice your pronunciation. Using your textbook and a medical dictionary, find the meanings of the underlined medical terms.

This was a routine admission of a 49-year-old woman for open cholecystectomy. She had a 12-month history of cholelithiasis, pain associated with nausea and vomiting. She was admitted in the previous December with probable cholecystic perforation. At the time she had an acute rise of 5.5 L. An ultrasound at this time revealed gallstones, the common bile duct was not dilated.

Open cholecystectomy was performed under general anaesthesia (ASA, 1-NE) on 21.3.16 via a Kocher incision. An operative cholangiogram at this time revealed filling defects with an obstructed flow into the gallbladder. Subsequently, the common bile duct was explored and multiple stones were removed. Following this, a T-tube was inserted.

Postoperatively, she suffered some pain at the site of the T-tube. She also had some transient fever. This was not thought to be related and the pain was attributed to irritation of the T-tube in the abdominal wall. A T-tube cholangiogram performed on day 7 showed cholangiography has a good flow into the common bile duct, but no further stones appear. A T-tube cholangiogram following this procedure showed good flow into the ductus with no further stones apparent. The T-tube was then removed without any further problems. The patient was discharged home with review in Surgical Outpatient planned.
Exercise 11.8: Crossword Puzzle

Complete the puzzle by providing the medical term for each of the clues below.

ACROSS

3. ball of food (5)
4. a weight reduction procedure used to treat morbidly obese patients (7, 7)
5. breaking down food into smaller components to allow for absorption in the gastrointestinal tract (8)
6. inflammation of the liver that can result in damage to the cells in the liver (9)

DOWN

1. surgical removal of the gallbladder (15)
2. a series of tests measuring the enzymes and bilirubin in serum to identify liver disease (5, 6, 6)
3. the part of the large intestine between the cecum and the rectum (7)
4. the passage of digested food into the large intestine (11)
5. inflammation of the parotid glands (8)
6. a band of muscle in the mouth (5)
7. means with food to lubricate and to aid in all microorganisms (9)
Exercise 11.9: Anagram

Match the medical term from the jumbled letters below. Then, using the letters in brackets, determine the medical term that matches the description given:

1. aevul __ __ __ __ __ __
   Large organ located in the RUQ

2. sigmad __ __ __ __ __ __
   Perforating between the small and large intestine

3. osul __ __ __ __ __ __
   Third part of the small intestine

4. gaddhyp __ __ __ __ __ __
   Difficulty in swallowing

5. meson __ __ __ __ __ __
   First part of the large intestine

Rearrange the letters in brackets to form a word that means 'the semi-fluid contents of the stomach'.

Exercise 11.10: Discharge Summary Analysis

Read the Discharge summary below and answer the questions:

[Discharge summary content]

1. **Consultant**: Dr. Memon
2. **Discharge status**: Home
3. **Date of discharge**: 11/4/2018
4. **Initial diagnosis**: Gastric ulcer
5. **Previous medical history**: Anemia
6. **Complications**: Nil reported
7. **Clinical assessment**: Overview of perforated gastric ulcer
Chapter 11: Diagnostic System

Diagnostic interventions:
- chest x-ray
- LFTs and amylase were normal

Medications at discharge:
- Zantac

Cessation medications: Nil reported

Allergies: Nil reported

Allergic: Nil reported

Arranged services: Nil reported

Recommendations: For review in 6 weeks in Surgical Outpatients.

Information to patient/relevant parties:
For review in 6 weeks in Surgical Outpatients.

Authorizing clinician: Dr. Ramg

Document review:

1. Expand the following abbreviations as found in the discharge summary above.
   - ED
   - Hx
   - LFTs
   - LMO
   - N&V
   - NSAID
   - RVP
   - WCC

2. It is stated that Mr. Green had an acute abdomen. What does this mean?

3. Mr. Green has been taking aspirin for many years for his rheumatoid arthritis. Does research show a link between long-term ingestion of aspirin and gastric ulcers?

4. What does perforation of a gastric ulcer mean and why is it a serious condition?

5. Why was Mr. Green discharged on Zantac medication?
QUESTIONS?
alkhaleel@ksu.edu.sa