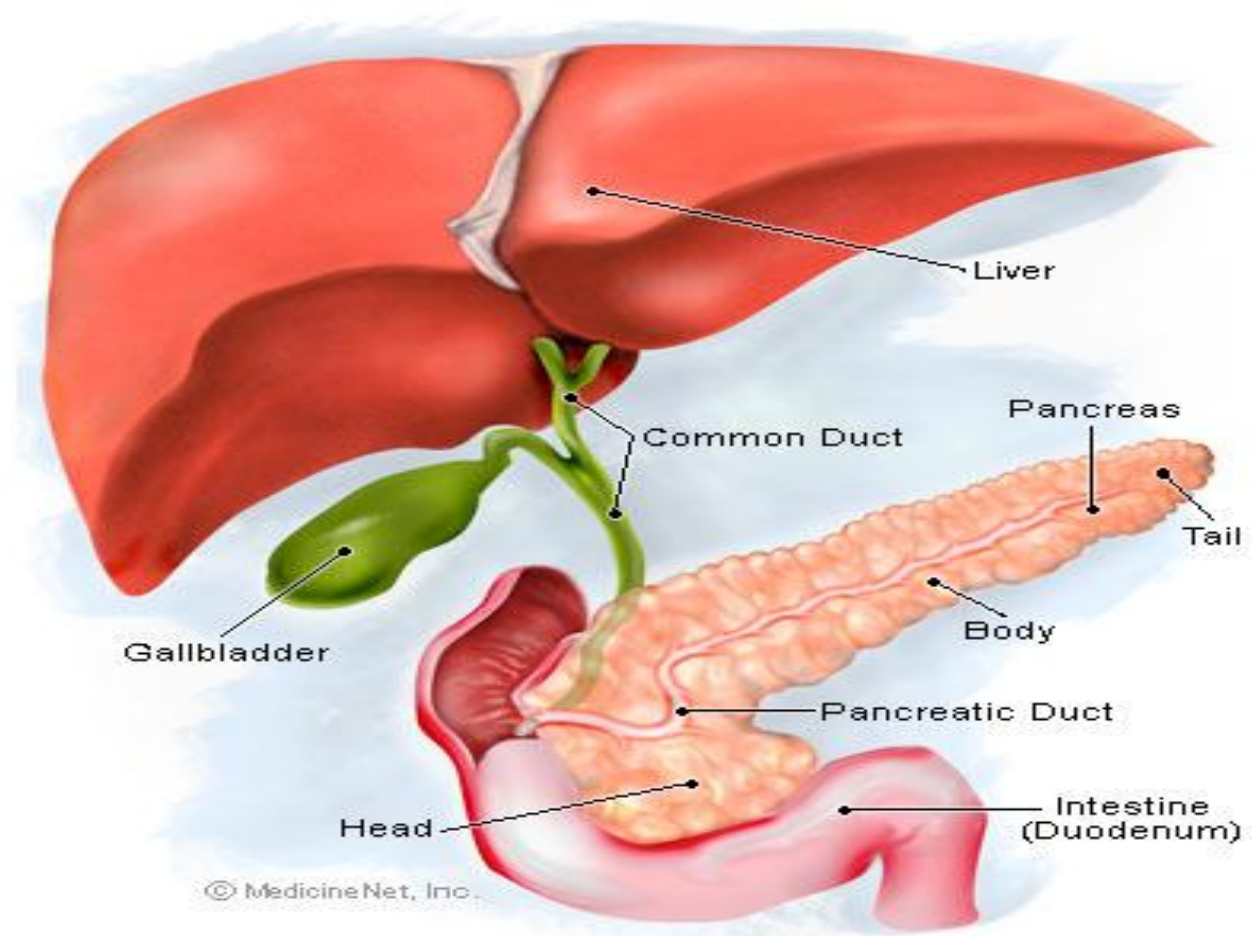


5th Lecture Motility and Secretion in the Small Intestine



PHYSIOLOGY TEAM - 430

This Lecture is done by :

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Motility and Secretion in the Small Intestine

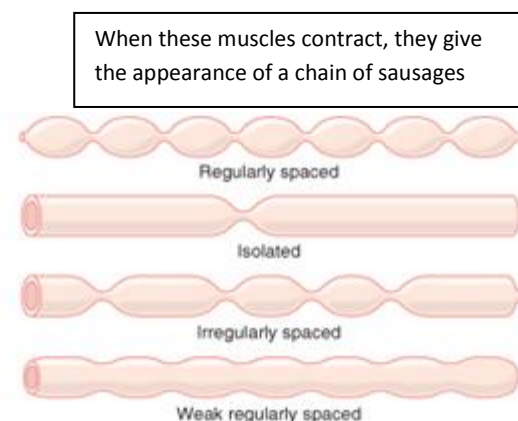
❖ The movements of the small intestine can be divided into:

- 1- **Mixing** Contractions. (Segmentation Contractions)
- 2- **Propulsive** Contractions.
- 3- **Migrating Motor complex**.
- 4- **Peristaltic** Rush.
- 5- **Antiperistalsis**.

1- **Mixing Contractions: (Segmentation Contractions)**

- Ring-like contractions.

Distention of small intestine by food “ Chyme ” → **ENS**
Activates the **circular** muscles → **Contractions** of circular muscles in some areas for a while, then **relaxation** of these muscles and contractions occur in different areas → So the chyme will be **chopped** into smaller portions .



Other important purposes for mixing contractions

- **Blend** different juices with the chyme
- Bring products of digestion in contact with **absorptive surfaces**. (Bringing chyme closer to the mucosa to get absorbed).

2- **Propulsive Movements:**

- Occur in any part of the **small** intestine.
- Usually stimulated by **Distention**
- At a velocity of **0.5 to 2.0 cm/sec**.
- They are faster in the **proximal** intestine and slower in the terminal intestine.

(because once we reach the terminal ileum we need enough time to get the materials back via different transport mechanisms, to give them time to get back to the portal circulation)

- They normally are very weak after traveling only 3 to 5 centimeters.
- Net movement along the small intestine normally **averages only 1 cm/min** → So **3 to 5 hours are required for passage of chyme** from the pylorus to the ileocecal valve.
- Organizes propulsion of chyme over variable distances within the intestinal lumen.
- **Myenteric plexus** is important for **Propulsive** movements

- Mechanism of propulsive movements:

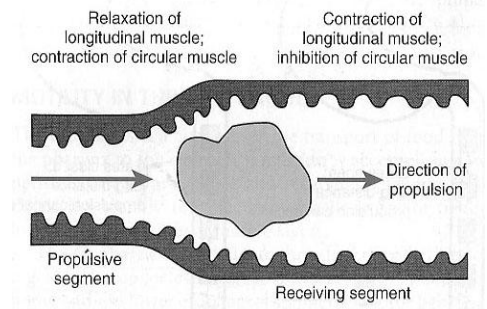
Propulsive Segment	Receiving Segment
contraction of circular m.	contraction of longitudinal m.
relaxation longitudinal m.	relaxation of circular m.

Atropine (cholinergic blocker) depresses these movements
→ **Constipation**

N.B.

Circular muscles contract → **constricting passageway and pushing chyme forward**

Longitudinal muscles contract → **shortening passageway ahead of chyme**



People who don't have enough propulsive movement they're susceptible to have **constipation**.

3- **Migrating Motor complex (MMC):**

* Digestive state:

When nutrients are present and digestive process are ongoing

* Interdigestive state :

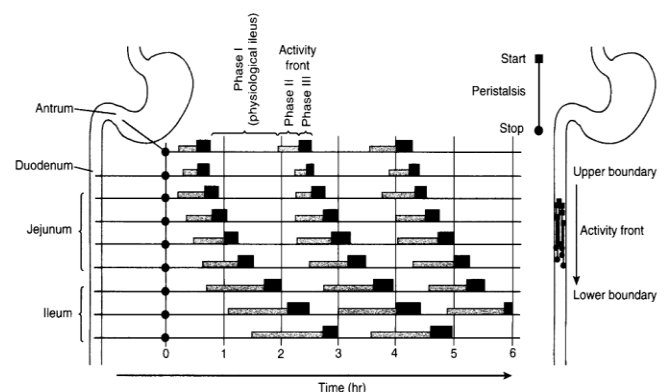
When the digestion and absorption of nutrients are completed, **2-3 hours after a meal**

- MMC are movements in the **"Interdigestive State"** in the **stomach & small intestine**.
- Bursts of electrical & contractile activities that are separated by longer quiescent periods
 - **Quiescent**: potential but there's no activity.

MMC occur in areas of **slow waves**

- It happens during **fasting**, conscious and sleep stages.
- Begins at distal stomach (**antral pump region**) to the **ileum** → The antral contraction to propel the remaining materials bigger than **7mm**.

- Every contraction** consists of the upper boundary (starting point, antral pump region), lower boundary (the **stop point** at which the contraction finishes, Ileum) and the activity front.



Activity front = the contracted segment

Every activity front goes through **3 phases**:

- 1- **Physiological Ileus**: (the quiescent period that **should** precede the activity front).
- 2- The **Activity Front**: (Presented by electrical waves).
- 3- The **Contractile events**.

- It takes **80-120 min for one activity front** (from the antrum to the ileum)
- the speed of the activity front is
 - Duodenum → 3-6 cm/min
 - Ileum → 1-2 cm/min
- **MMC** are organized by enteric nervous system (ENS) and:
 - Stimulated by motilin → It gets released when we don't have food in the digestive tract "during fasting"
 - Inhibited by CCK and Gastrin → get released when we have fatty acids or distended stomach, which means when we're not fasting.
- MMC keep cycling till they are ended by *ingestion of food (presence of a meal in the upper digestive tract) → Vagal efferent → signals to ENS → interrupt the MMC and initiate mixing movements during ingestion of a meal.*

So if the vagus nerves are cut there will be no interruption of (MMC) "The Interdigestive State" unless a large quantity of meal is ingested, and still the interruption is often incomplete.

- Intravenous feeding **does not end the fasting pattern "MMC"**

(Because we can't stop MMC unless we have the food exists in the stomach or in small intestine)

- **Adaptive significance of MMC**

- Gallbladder contraction and delivery of bile to the duodenum is coordinated with the onset of MMC in the intraduodenal region
- Appears also to be a mechanism for cleaning **indigestible materials**. (materials that larger than 7mm)
- Plays a **housekeeper role** in preventing the overgrowth of **microorganisms** that might occur in the small intestine

- MMC Start when we **are fasting**, when there's no food in the digestive tract
- The purpose of MMC is to move undigested residue toward colon to maintain low bacterial counts in upper intestine.
- **Occur only between meals.**

4- **Peristaltic Rush:**

- **Powerful rapid** peristalsis due to severe irritation of intestinal mucosa as in **infectious diarrhea**.
The purpose of this movement is to **relieve the intestine from irritative chyme or over distention**.

5- **Antiperistalsis**

- In the **opposite direction** occur between stomach and duodenum to allow more time for **neutralization** of chyme and between ileum and cecum to allow time for absorption
- It might begin in the distal part of the **small intestine (Ilium)**
- The antiperistaltic wave travels backward up the intestine at a rate of 2 to 3 cm/sec.
- The role of **antiperistalsis** in vomiting:
 - When the upper portions of GIT, especially the duodenum become overly **distended** → This **distention** becomes the exciting factor that initiates the actual vomiting act.

N.B. We didn't talk about the submucosal neuronal layer **because it doesn't deal with motility, it's for secretion**

Neutralization: The interaction between an acid and a base that produces a solution that is neither acidic nor basic

❖ **Control of Peristalsis by Nervous and Hormonal Signals:**

Neural effects:

Peristaltic activity of the small intestine is **increased** after a meal.

(Entry of chyme into the duodenum → **stretch** of the duodenal wall)

This mechanism is known as **gastroenteric reflex**, it's mainly conducted through the **Myenteric plexus** from the stomach down along the wall of small intestine.

Hormonal factors:

- **Gastrin, CCK, Insulin and Motilin**. (All of them enhance intestinal movement)

CCK is the leader of these hormones, **it's more powerful**

❖ Ileocecal Valve

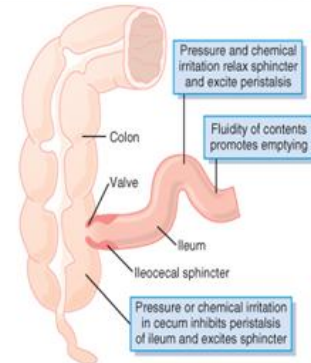
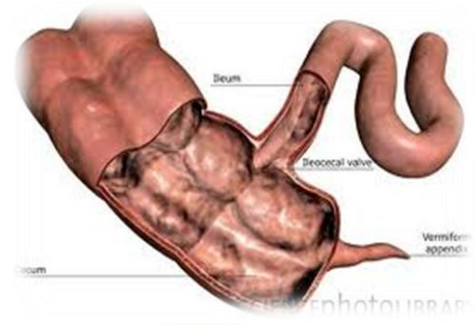
Main function is to **prevent the backflow of the fecal contents from the Colon to the Small Intestine**

Feedback Control of the Ileocecal Sphincter (Valve):

- controlled by reflexes from the cecum

(When the cecum is **distended** → contraction of the ileocecal sphincter becomes **more intense** → ileal peristalsis is inhibited).

The purpose is to delay emptying of additional chyme into the cecum from the ileum.



❖ Secretions of the Small Intestine

➤ **Brunner's** Glands in the Duodenum

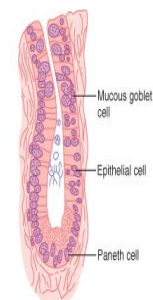
- Secretes **Mucus**.
- located in the **wall of the first few centimeters of the duodenum**.
- They secrete large amounts of **alkaline** mucus, which contains a large amount of **bicarbonate** ions, in response to:

- 1- **Irritating stimuli on the duodenal mucosa.**
- 2- **Vagal stimulation .**
- 3- **secretin.**

- They are inhibited by sympathetic stimulation.

➤ **Secretion of Intestinal Digestive Juices by the Crypts of Lieberkühn**

- **Crypts of Lieberkühn** are small pits which lie between the **intestinal villi**.
- The surfaces of both the crypts and the villi are covered by an **epithelium and it's composed of two types of cells**



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- 1- **Goblet cells** → Secrete mucus
- 2- **Enterocytes** → Secrete large quantities of water and electrolytes and over the surfaces of adjacent villi, reabsorb the water and electrolytes along with end products of digestion.

❖ Digestive Enzymes in the Small Intestinal Secretion

The enterocytes of the mucosa contain digestive enzymes. They are:

- **several peptidases** for splitting small peptides into → **amino acids**
- four enzymes: **Sucrase, Maltase, Isomaltase**, and **Lactase** for splitting **Disaccharides** into → **Monosaccharides**
- Small amounts of **intestinal Lipase** for splitting neutral fats into → **glycerol and fatty acids**.