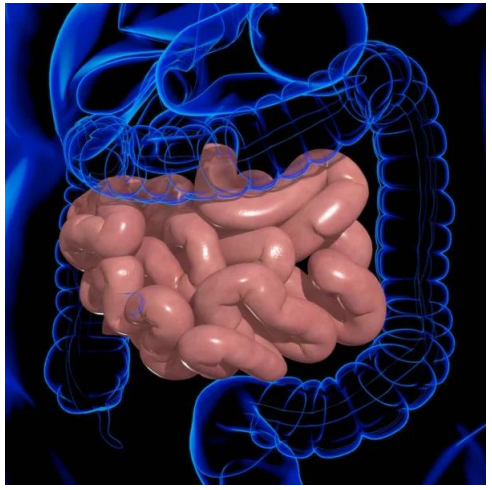
Ashur University
College of Medicine

Grade 2
PHYSIOLOGY OF
GASTROINTESTINAL TRACT
(GIT)
Lec. 4

Movement in Small & Large intestine



Ass. Professor Internal Medicine

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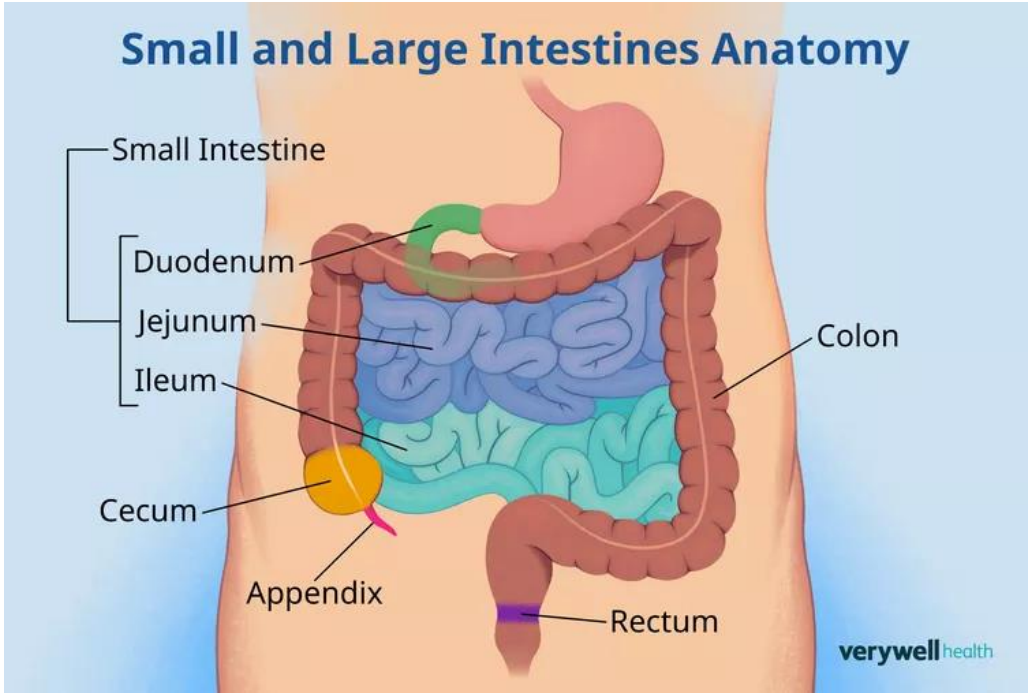
27/1/2025



Objectives:

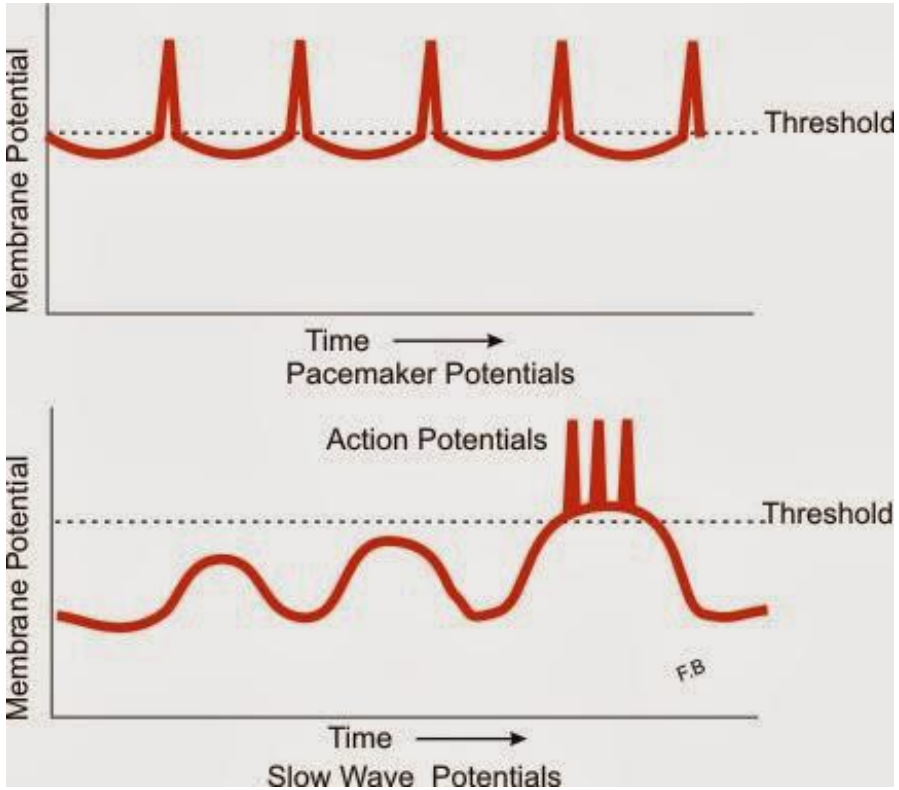
- Explain the movements in the small intestine.
- Outline the movements in the colon.
- Describe defecation reflex.



SMALL INTESTINE

Basic electrical rhythm (BER)

- The maximum frequency of the segmentation contractions in the small intestine is determined by the frequency of electrical slow waves in the intestinal wall, which is the **Basic Electrical Rhythm (BER).**
- **BER is initiated by the interstitial cells of Cajal,** which are stellate mesenchymal pacemaker cells.In the small intestine, these cells are located in the outer circular muscle layer near the myenteric plexus.
- The rate of the **BER is about 4/min in the stomach**. It is about **12/min in the duodenum** and falls to **about 8/min in the distal ileum**. In the colon, the BER rate rises from about **2/min at the cecum** to about **6/min at the sigmoid.**



MOVEMENTS IN THE SMALL INTESTINE

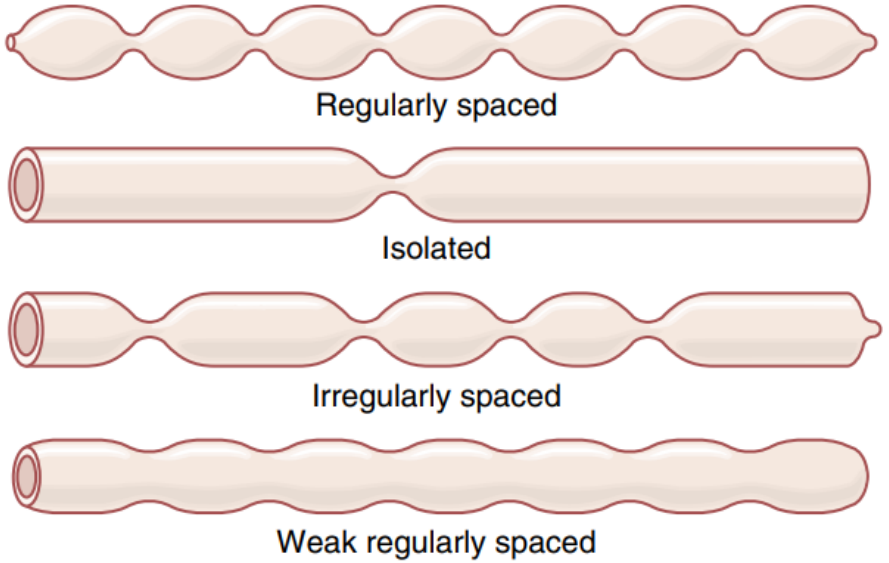
1-Mixing or segmentation contraction:

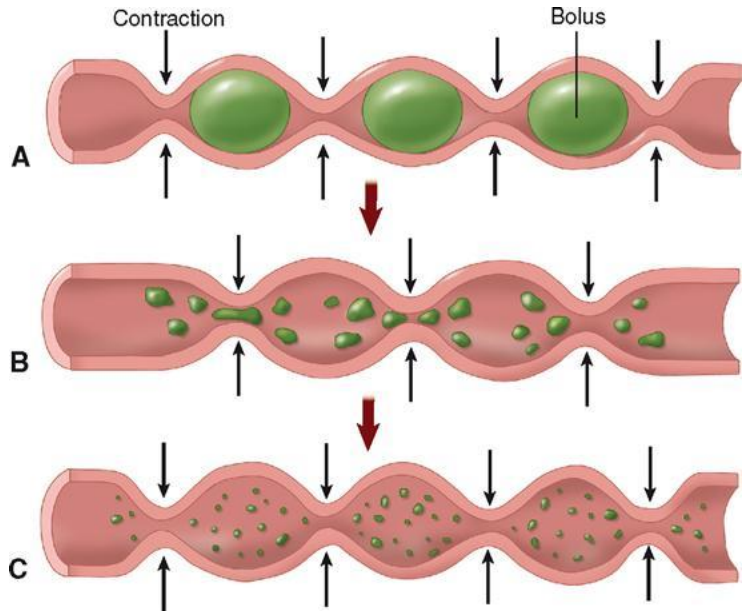
The contractions cause **"segmentation"** of the small intestine, they divide the intestine into spaced segments that have the **appearance of a chain of sausages.**

The maximum frequency of the segmentation contractions in the small intestine is determined by the frequency of electrical slow waves in the intestinal wall.

The segmentation contractions become weak when the excitatory activity of the enteric nervous system is blocked by the **drug atropine.**

Atropine : anticholinergic or antiparasympathetic (parasympatholytic) drug. Atropine functions as a sympathetic : ↑heart rate , ↓ salivation.





Segmentation of the small intestine:

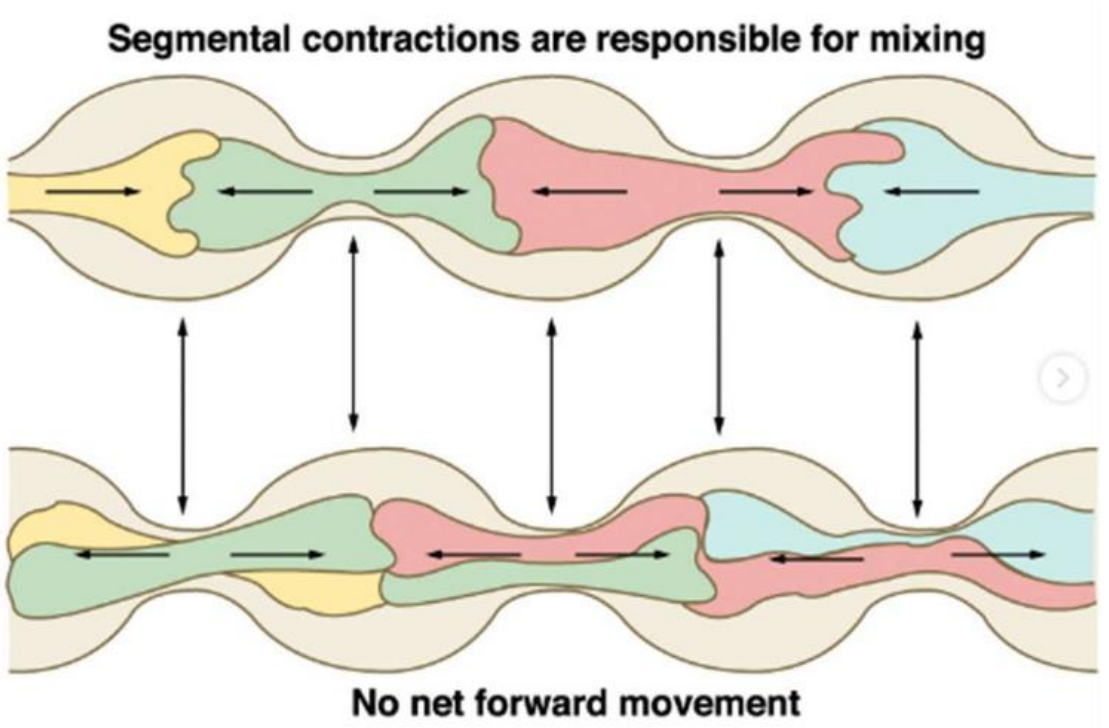
The small intestine has three parts: the duodenum, jejunum, and ileum.

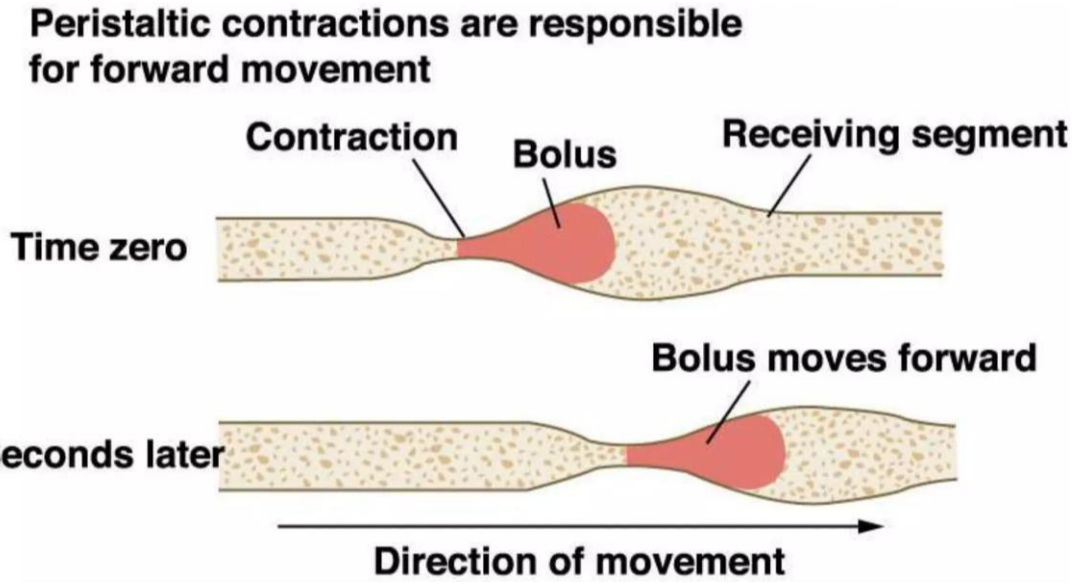
The **contraction of intestinal circular smooth muscles** that mixes chyme is called **segmentation.**

Segmentation mix the chyme with digestive enzymes and mucus.Promote digestion and absorption.

Segmentation involves contractions of the circular muscles in the digestive tract while **peristalsis involves rhythmic contractions of the longitudinal muscles** in the gastrointestinal tract.

Segmentation actually can slow progression of chyme through the intestine.

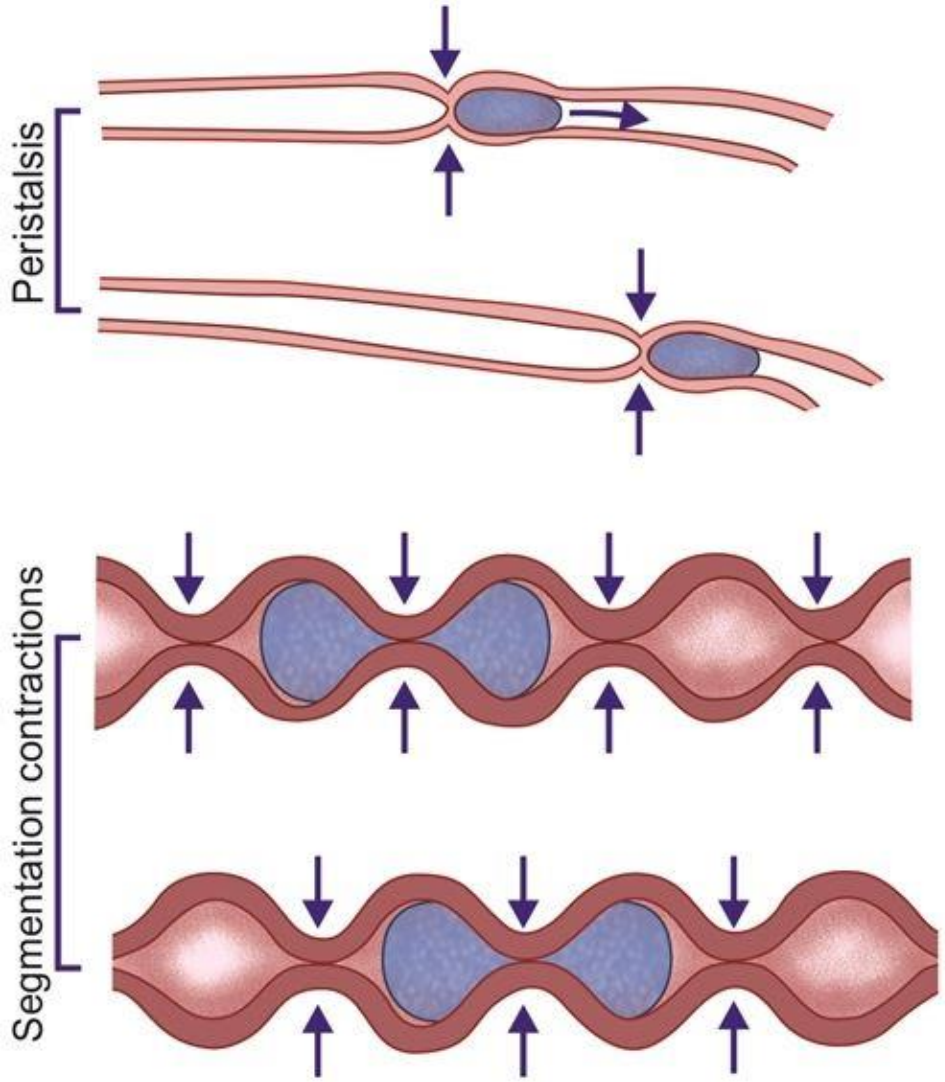




2-Tonic contractions:

are relatively prolonged contractions that in effect isolate one segment of the intestine from another.

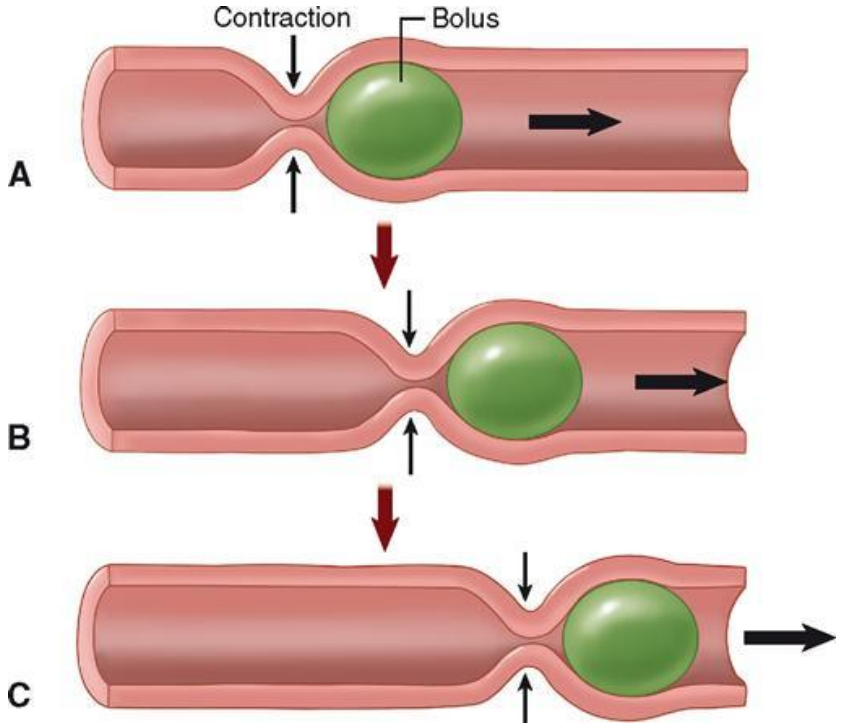
The segmentation contractions and the tonic contractions slow transit in the small intestine to the point that the transit time is actually longer in the fed than in the fasted state.

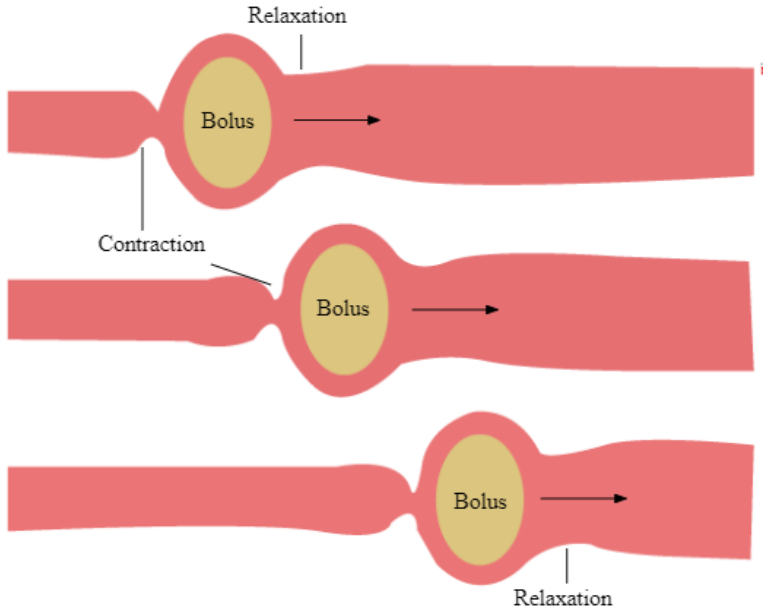


3- Propulsive or peristaltic movement:

Chyme is propelled through the small intestine by peristaltic waves.

These waves can occur in any part of the small intestine and **move toward the anus** at a velocity of 0.5 to 2.0 cm/sec— faster in the proximal intestine and slower in the terminal intestine. So forward movement of the chyme is very slow—so slow that net movement along the small intestine normally averages only **1 cm/min**. This rate of travel means that **3 to 5 hours are required for passage of chyme from the pylorus to the ileocecal valve**.





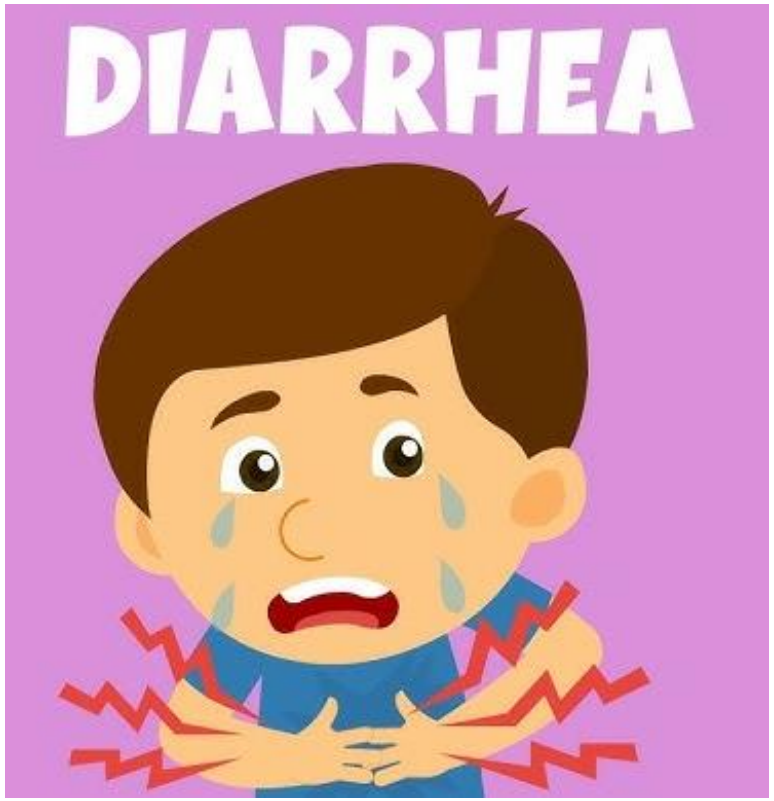
4- Peristaltic rush:

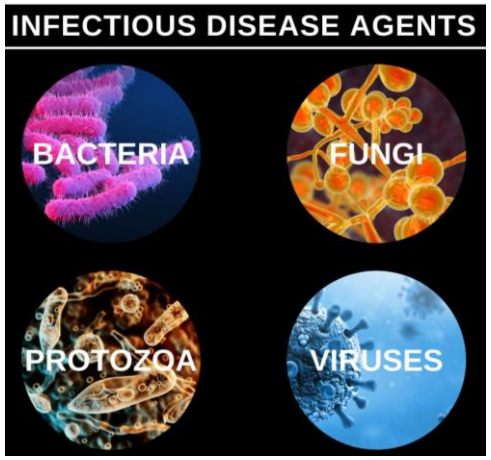
→ Powerful, Rapid Peristalsis.

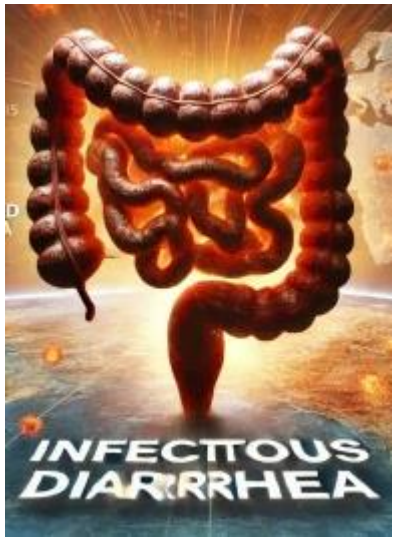
Although peristalsis in the small intestine is normally weak, intense irritation of the intestinal mucosa, as occurs in **some severe cases of infectious diarrhea, can cause both powerful and rapid peristalsis, called the peristaltic rush.**

The powerful peristaltic contractions travel long distances in the small intestine within minutes.

Peristaltic rush sweeps the content of intestine to the colon.







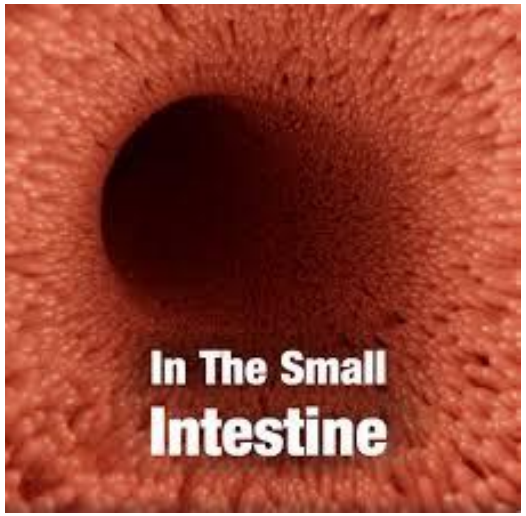


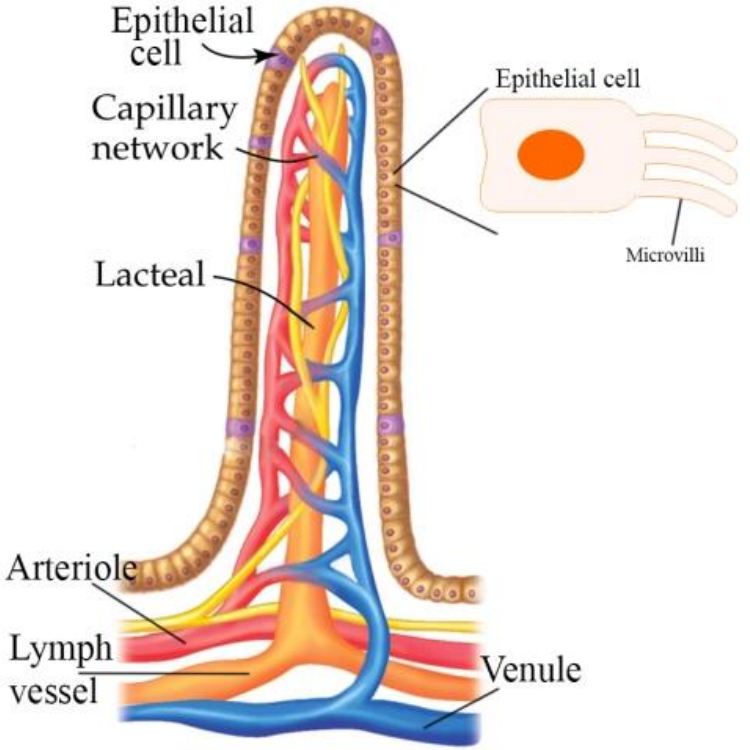
5- Movements caused by muscularis mucosae and muscle fiber of the villi:

The muscularis mucosae can cause short folds to appear in the intestinal mucosa.

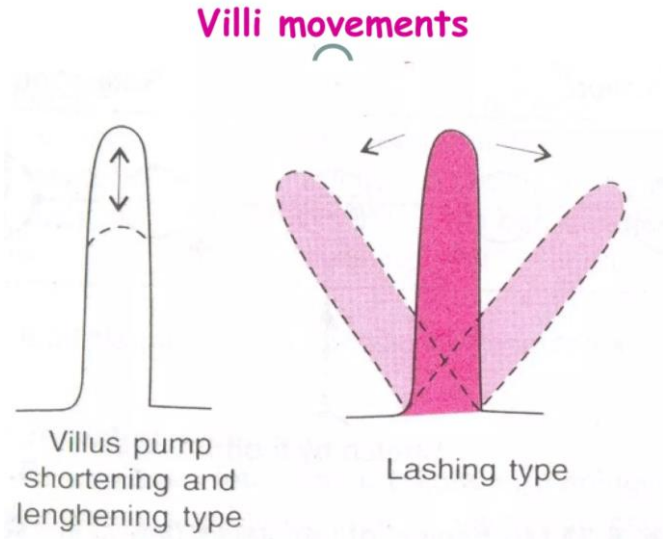
The mucosal folds increase the surface area exposed to the chyme, thereby increasing absorption.

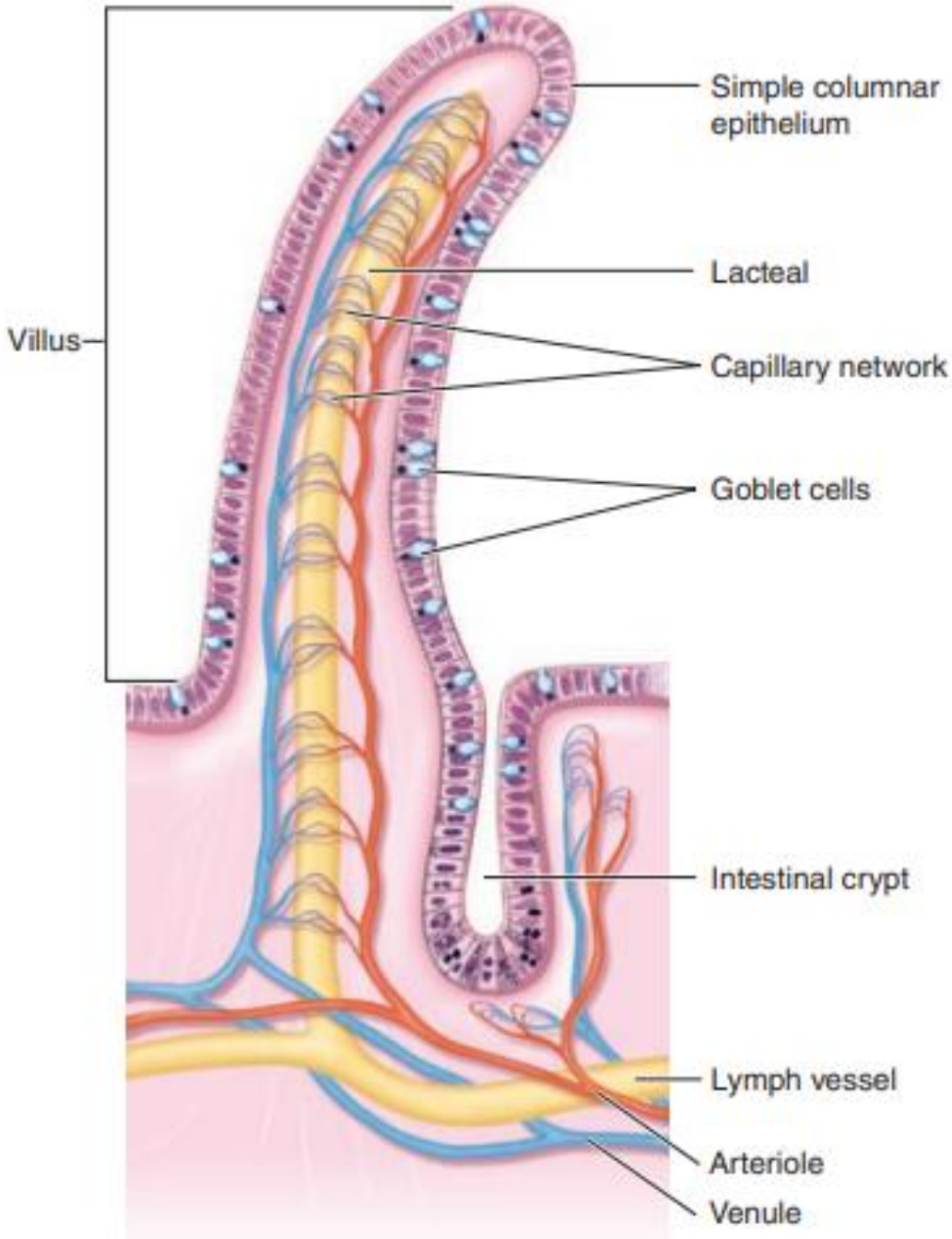
Also, **contractions of the villi**— shortening, elongating, and shortening again— "milk" the villi so that **lymph flows freely from the central lacteals of the villi into the lymphatic system**.











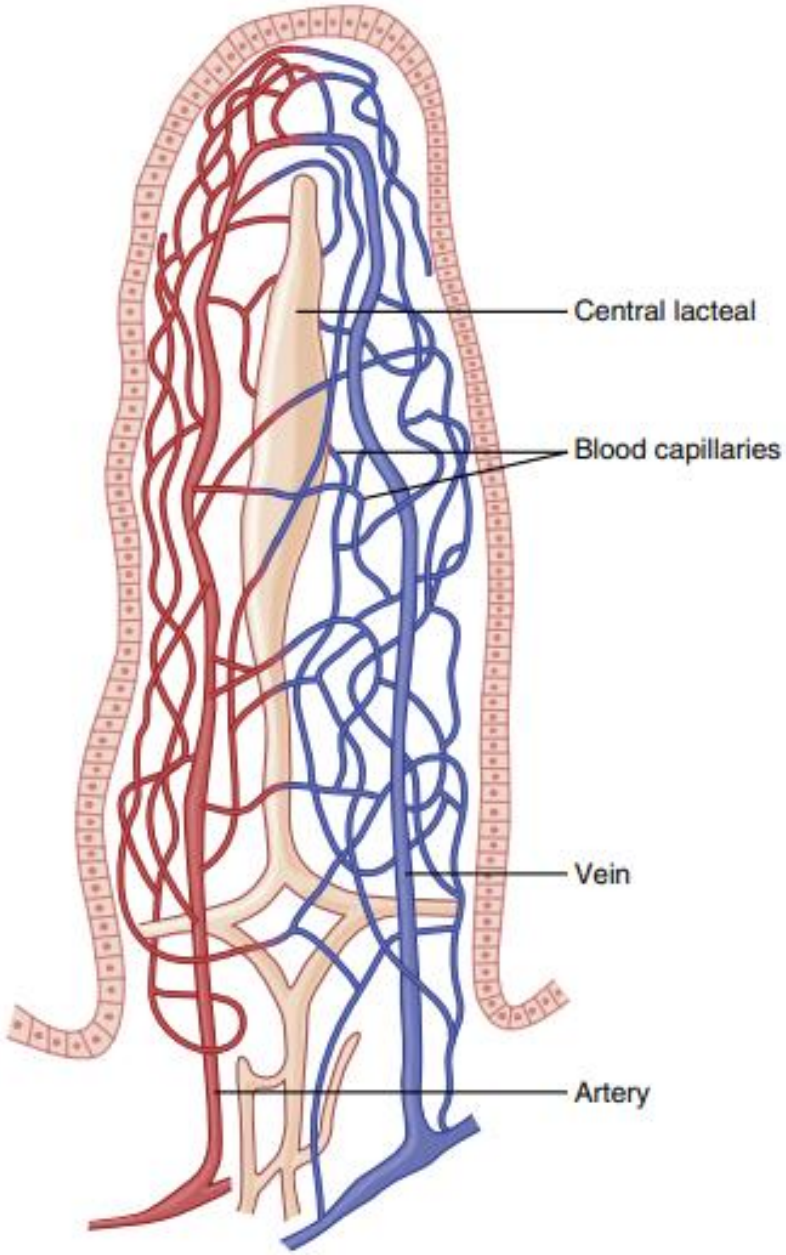


FIGURE :

The structure of intestinal villi and crypts.

Movements in the colon:

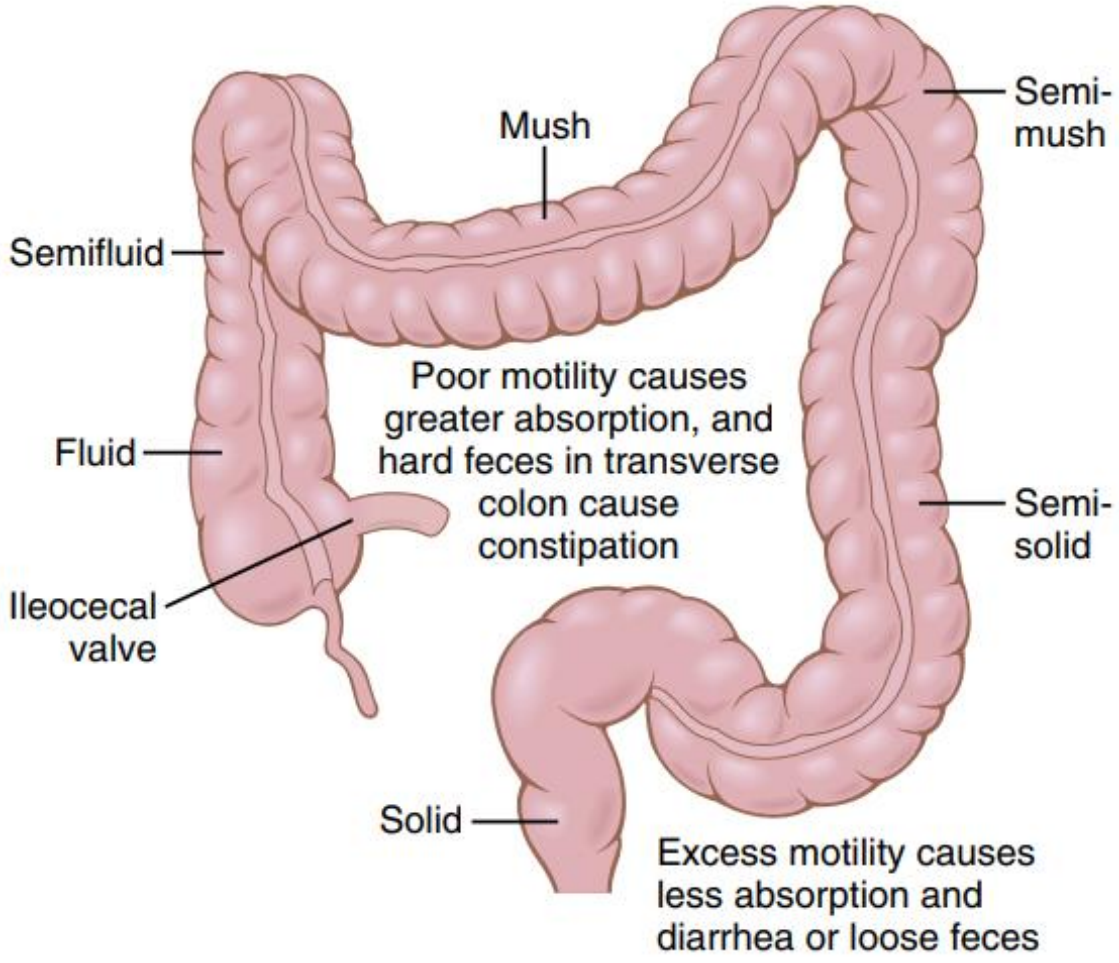
The principal functions of the colon are

(1) absorption of water and electrolytes from the chyme to form solid feces and

(2) storage of fecal matter until it can be expelled.

The movements of the colon are coordinated by BER of the colon.

The frequency of this wave, unlike the wave in the small intestine, increases along the colon from about **9/min, at the ileo-caecal valve** to **16/min, at the sigmoid.**



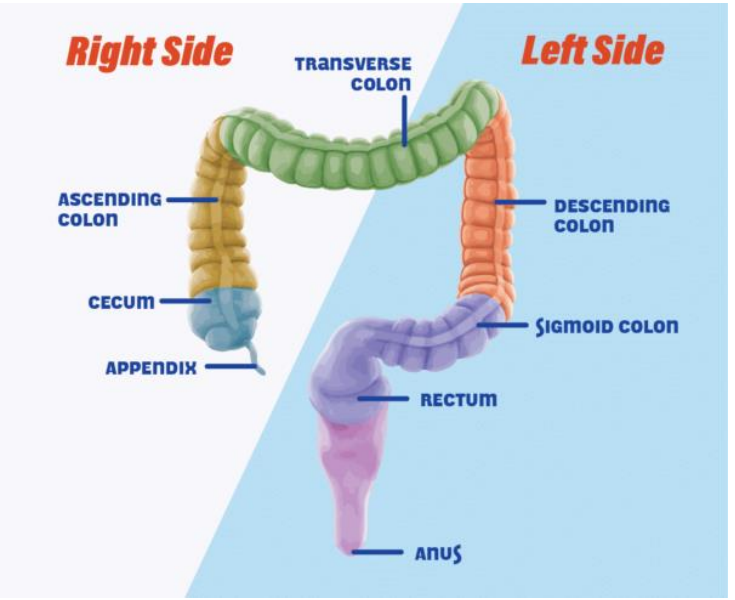
Types of movements of the colon:

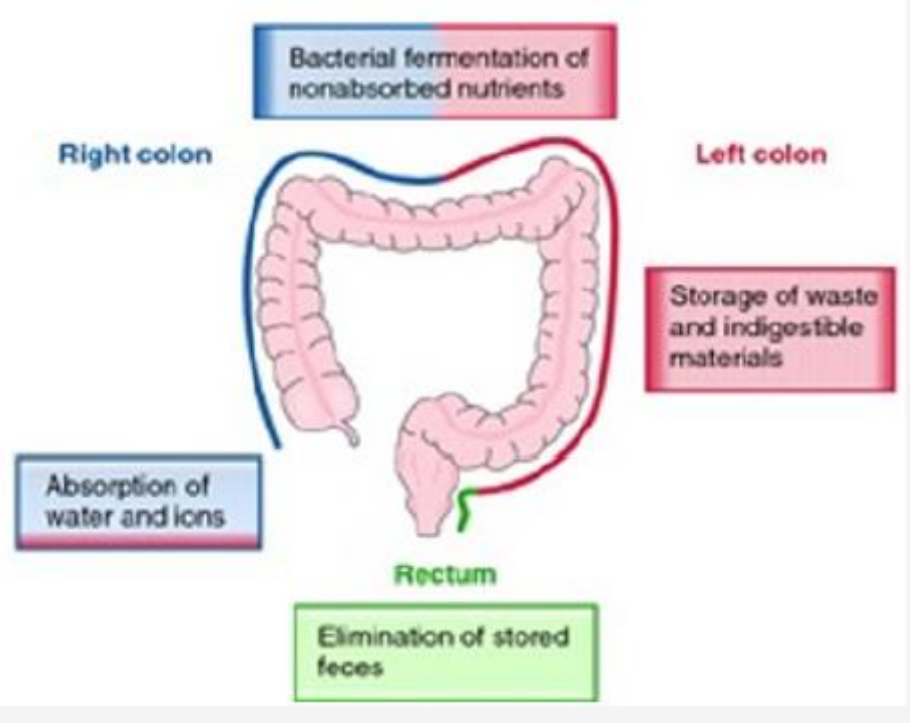
The motor activities in the colon are either:

1- Mix colonic contents and facilitate absorption.

2- Propulsion

- The proximal half **(Right colon)** of the colon is concerned principally with **absorption**, and the distal half **(Left colon)** concerned with **storage.**
- The **left colon and the rectum** are the **"storage tank"** at the end of the large bowel.



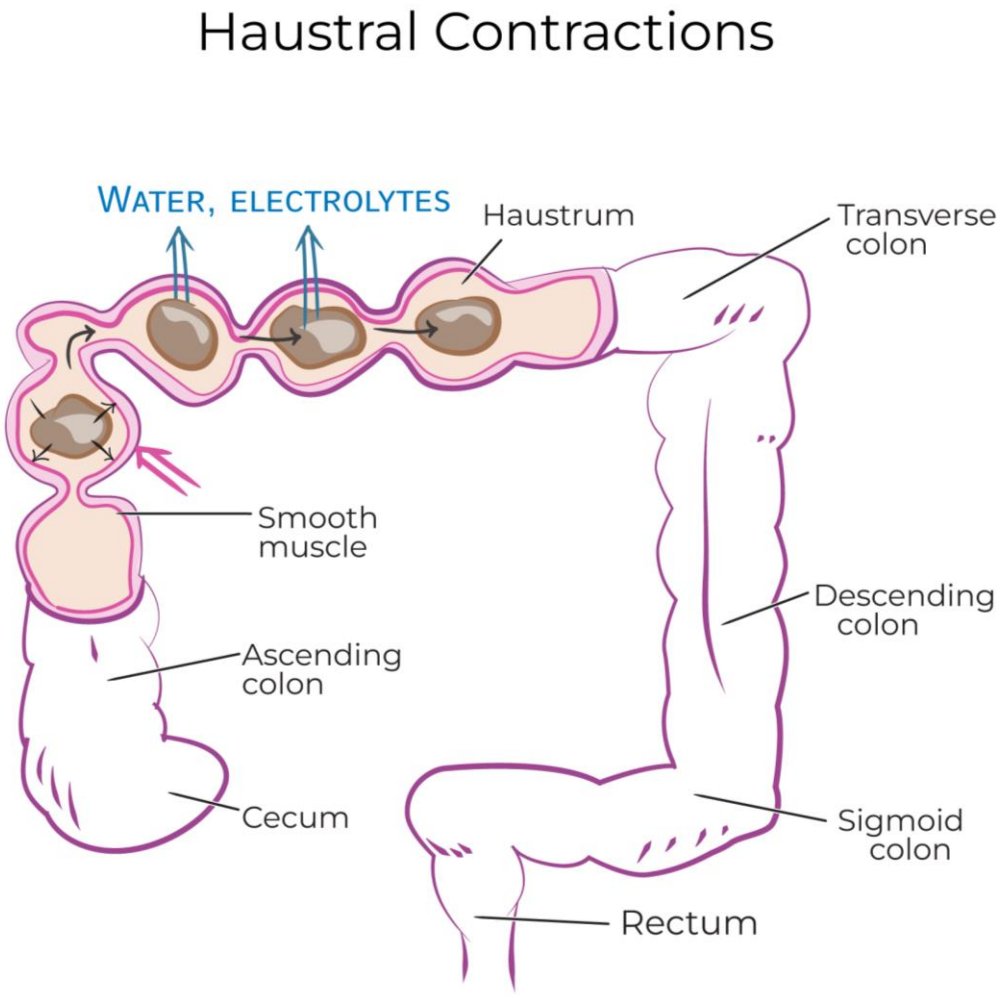


1- Mixing Movements— “Haustrations”

In the same manner that segmentation movements occur in the small intestine, large circular constrictions occur in the large intestine.

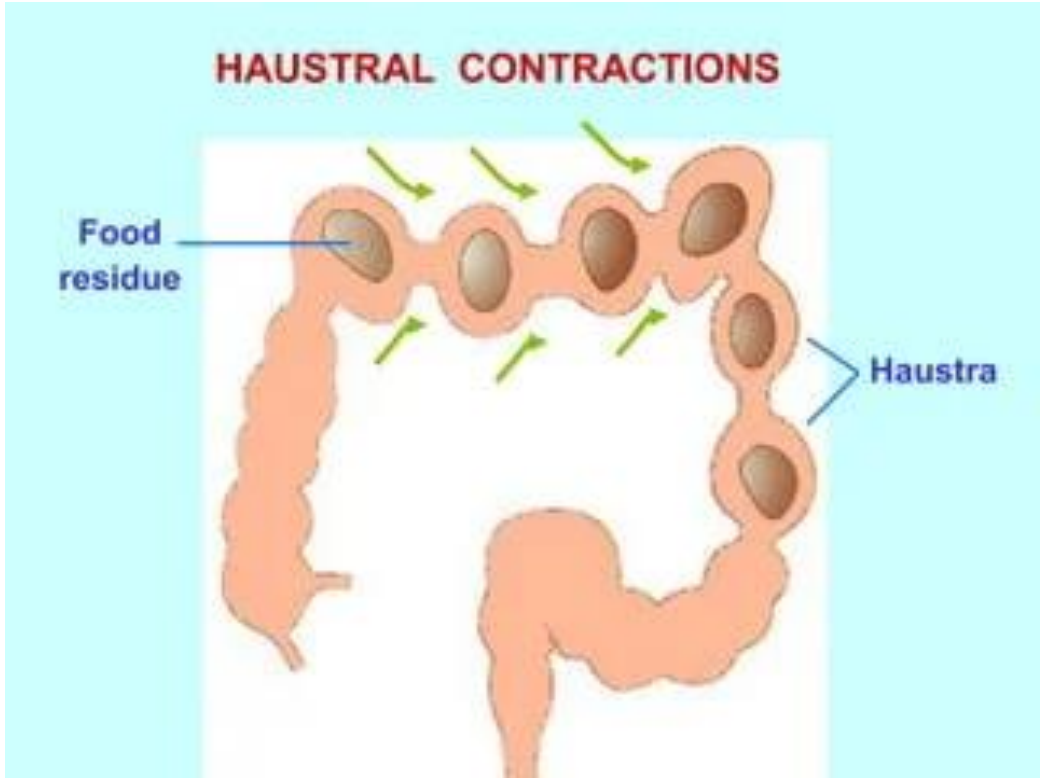
Each constrictions about 2.5 centimeters of the **circular muscle contract**, sometimes constricting the lumen of the colon almost to occlusion.

At the same time, **the longitudinal muscle** of the colon, which is aggregated into three longitudinal strips called the **teniae coli**, **contracts**.



The combined contractions of the circular and longitudinal strips of muscle cause the unstimulated portion of the large intestine to bulge outward into baglike sacs called haustrations.

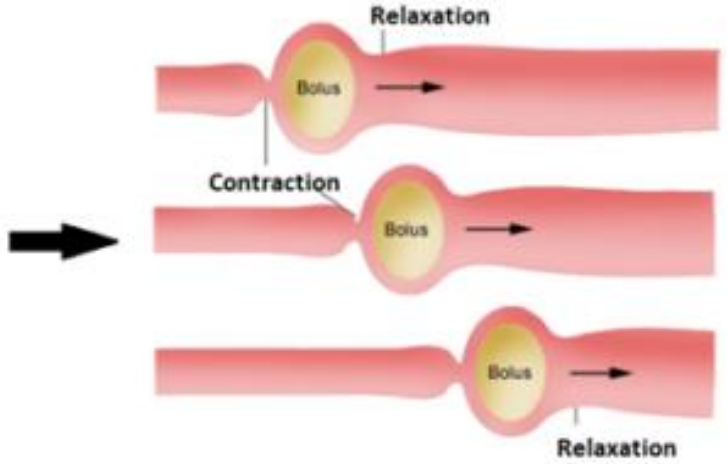
By haustral contractions the fecal material is gradually exposed to the mucosal surface of the large intestine, and fluid and dissolved substances (water and electrolytes) are progressively absorbed until **only 80 to 200 ml of feces are expelled each day.**



2- Peristaltic movement:

propel the contents towards the rectum.

Peristalsis = symmetrical contraction and relaxation of smooth muscle tissue in a sequence to produce a peristaltic wave which **propels food** along the gastrointestinal tract.

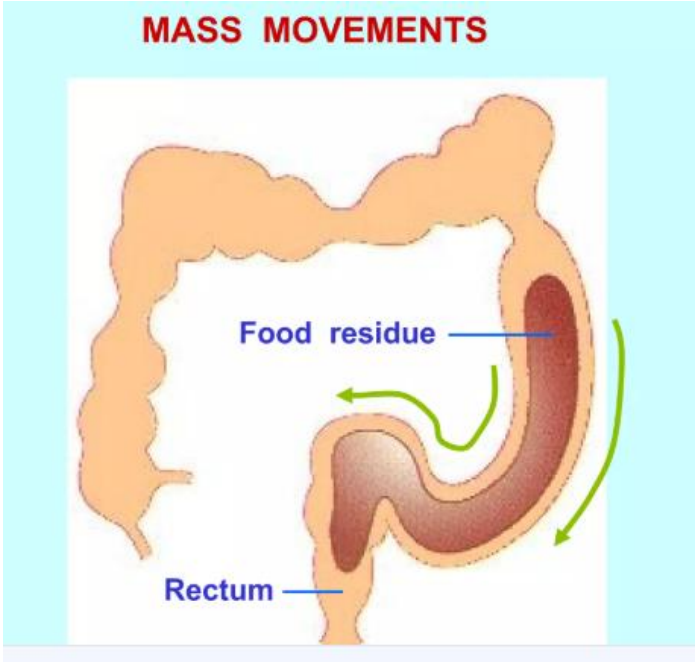


3- Mass peristalsis:

Propulsive Movements -"Mass Movements"

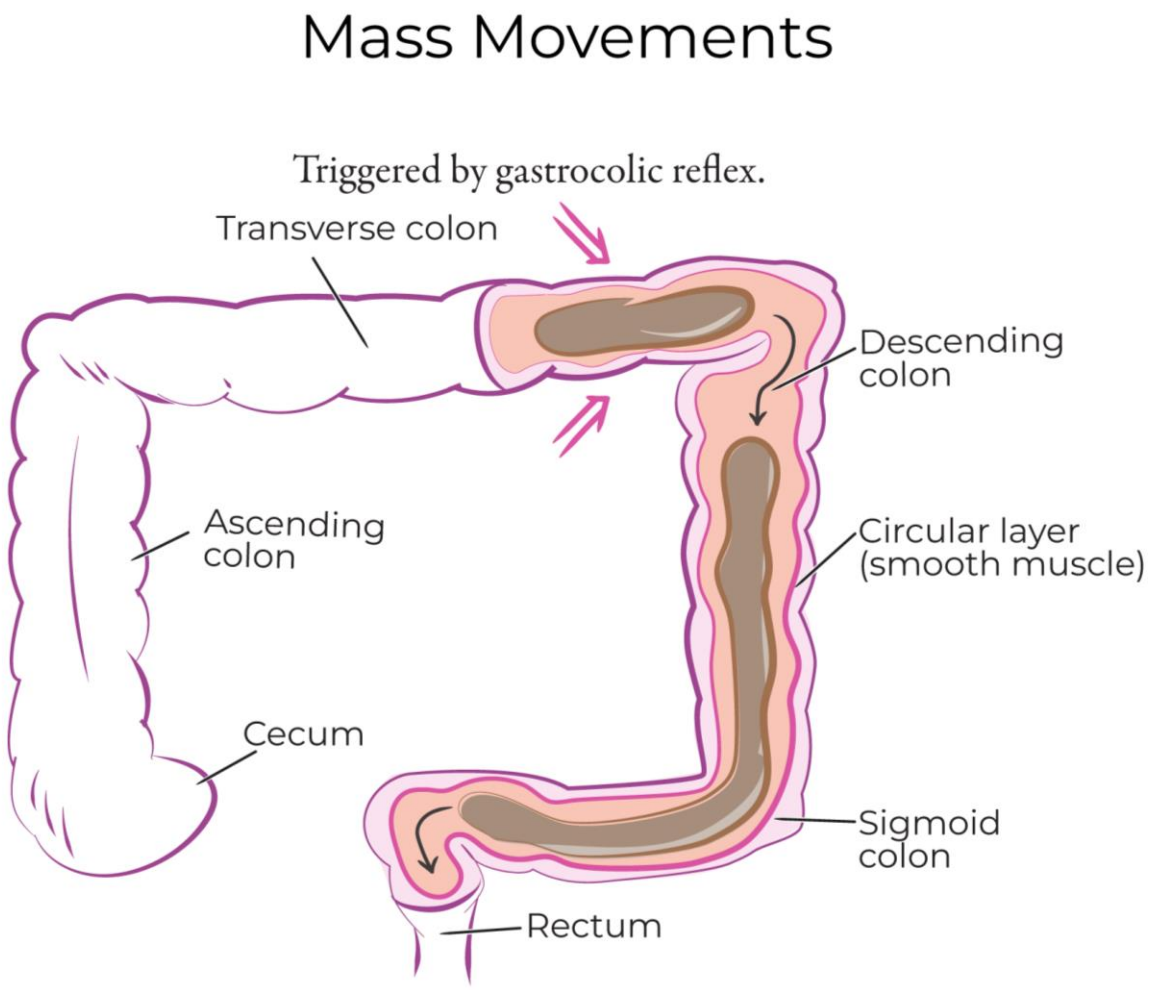
A mass movement is a modified type of peristalsis. **It occurs only in the colon**. Mass peristalsis occurs only a few times every day and they occur mostly after eating breakfast.

Mass movement, **is continuous and progressive**; it advances steadily **toward the anal end** of the tract, pushing waste material in front of the wave.



Mass Movements . . cont.

A constrictive ring occurs in response to a distended or irritated point in the colon, usually in **the transverse colon**. Then, rapidly, the 20 or more centimeters of colon distal to the constrictive ring **lose their haustrations** and instead contract as a unit, **propelling the fecal material** in this segment further down the colon.



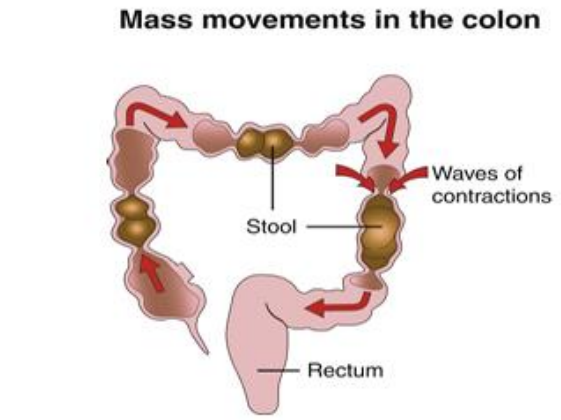
When mass movement have forced a mass of feces into the rectum, the desire for defecation is felt.

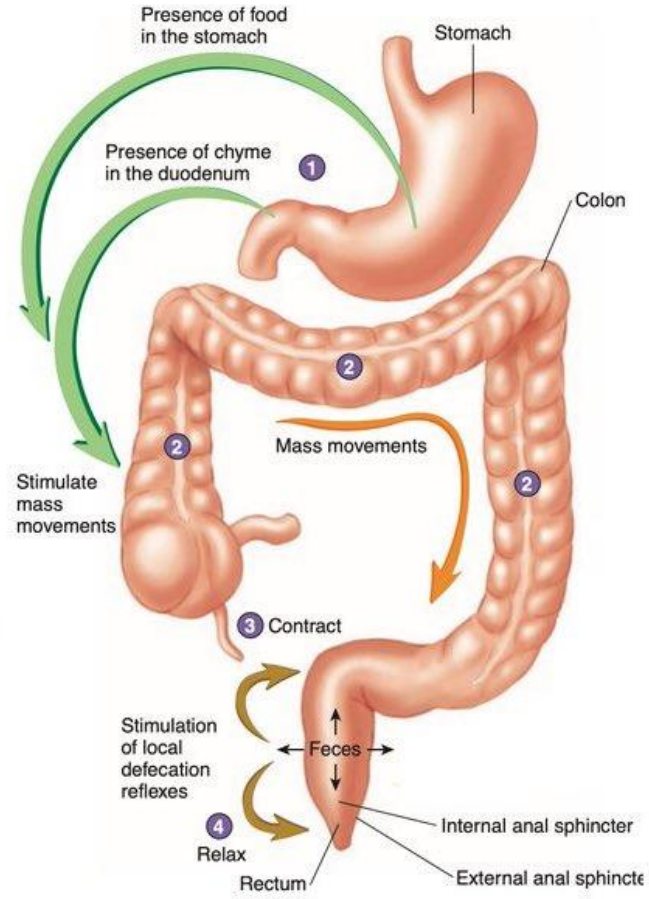
Mass movements occur usually after meal and particularly after breakfast or drinking fluids in the morning.

Mass movements after meals is facilitated by gastrocolic and duodenocolic reflexes. These reflexes result from distention of the stomach and duodenum.

Not all mass peristalsis result in the desire to defaecate.

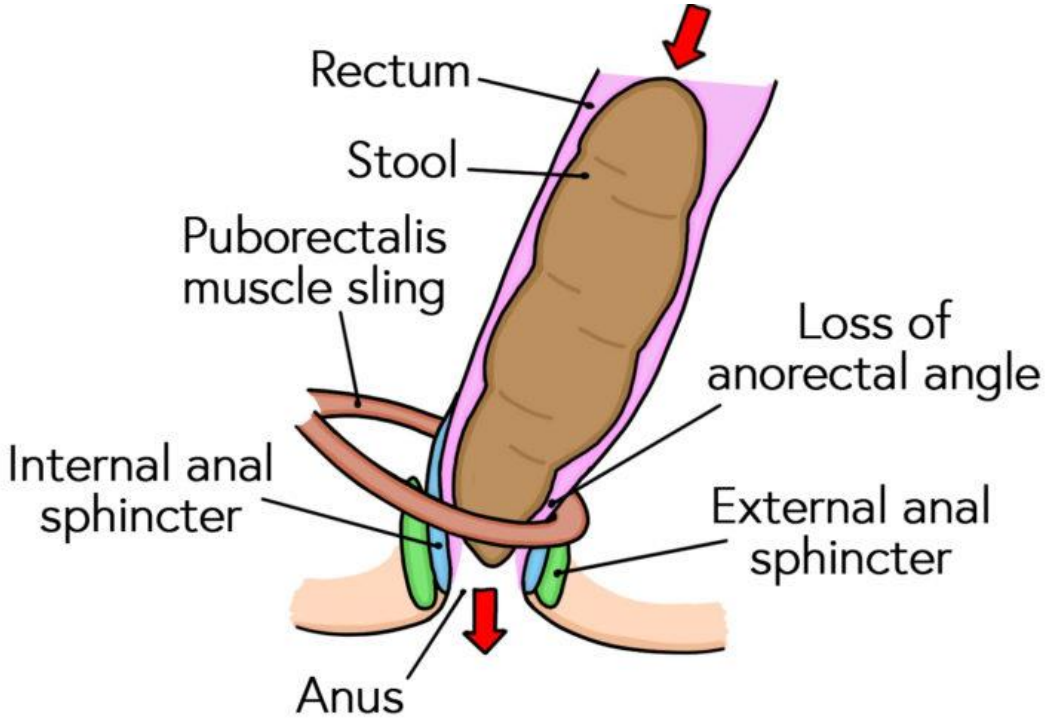
These **reflexes** almost are transmitted by way of the **autonomic nervous system** and **hormonal mechanism** (might be due to gastrin)





Defecation

- **Most of the time, the rectum is empty of feces**, partly because a weak functional sphincter exists about 20 centimeters from the anus at the juncture between the sigmoid colon and the rectum.
- **When a mass movement forces feces into the rectum, the desire for defecation occurs immediately,** including reflex contraction of the rectum and relaxation of the anal sphincters.



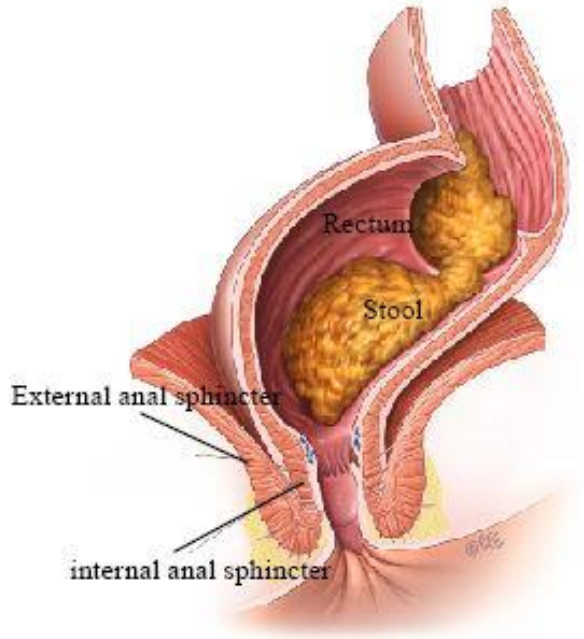
Sympathetic nerve supply to the internal (involuntary) anal sphincter is **excitatory**, whereas the

parasympathetic supply is **inhibitory**. This sphincter relaxes when the rectum is distended. **The nerve supply to the external anal sphincter, a skeletal muscle, comes from the pudendal nerve.**

- The urge to defecate first occurs when rectal pressure increases to about 18 mm Hg.

When this pressure reaches 55 mm Hg, the external as well as the internal sphincter relaxes and there is reflex expulsion of the contents of the rectum.

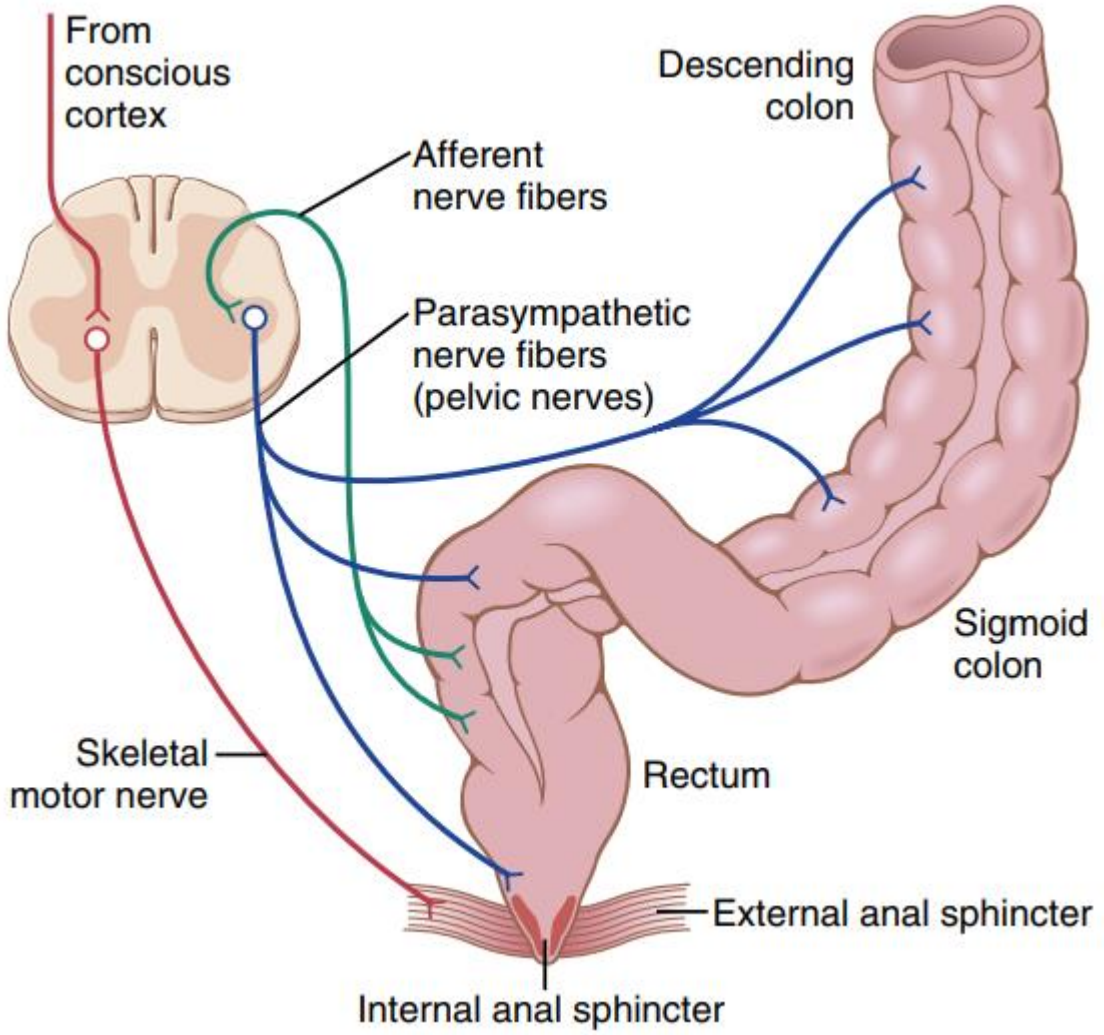




Defecation Reflexes:

defecation is initiated by defecation reflexes. One of these reflexes is an

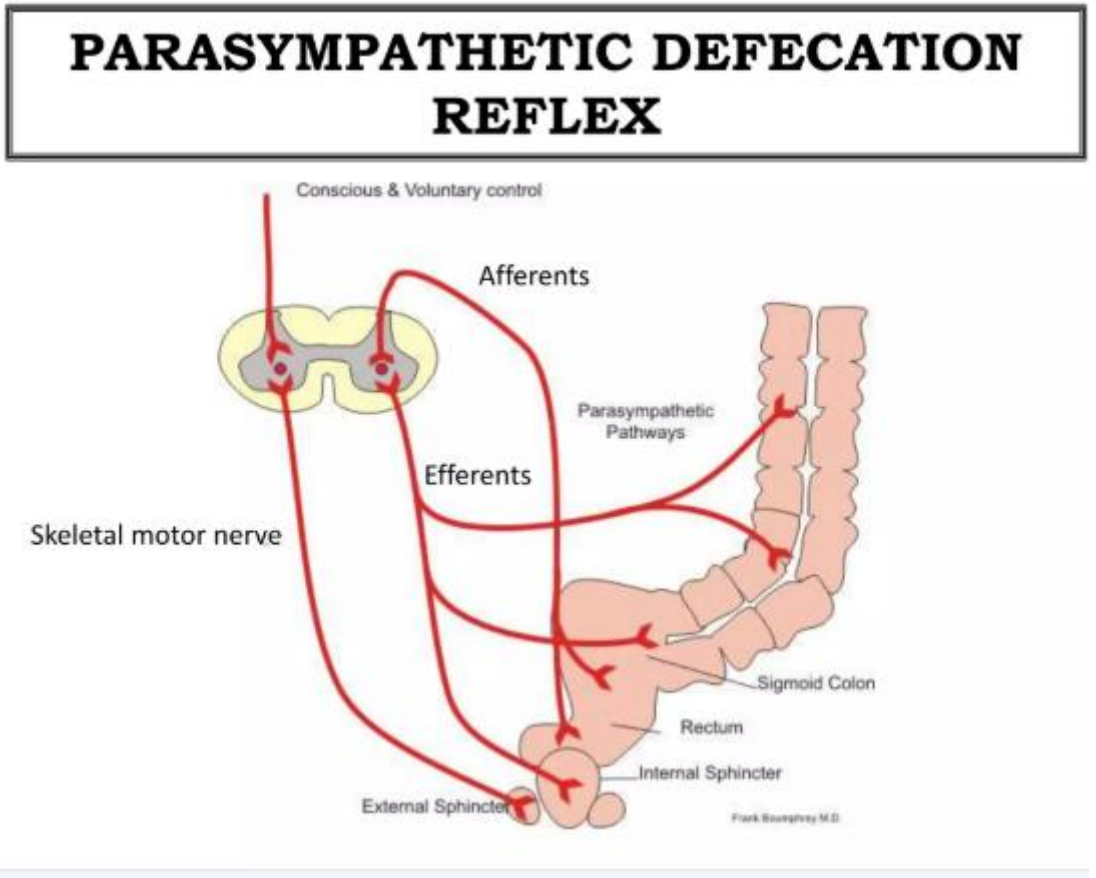
1-Intrinsic reflex : mediated by the local enteric nervous system in the rectal wall , distention of the rectal wall initiates afferent signals that spread through the myenteric plexus to initiate peristaltic waves in the descending colon, sigmoid, and rectum, forcing feces toward the anus.



2- Parasympathetic defecation reflex :

that **involves the sacral segments of the spinal cord**. These parasympathetic signals greatly intensify the peristaltic waves and **relax the internal anal sphincter**, thus converting the intrinsic myenteric defecation reflex from a weak effort into a powerful process of defecation that is sometimes effective in emptying the large bowel all the way from the splenic flexure of the colon to the anus.

The external sphincter is controlled by nerve fibers in the pudendal nerve, which is part of the somatic nervous system and therefore is under voluntary, conscious control.



- In **newborns** and in some people with **transected spinal cords**, the defecation reflexes cause **automatic emptying** of the lower bowel at inconvenient times during the day because of **lack of conscious control** exercised through voluntary contraction or relaxation of the external anal sphincter.





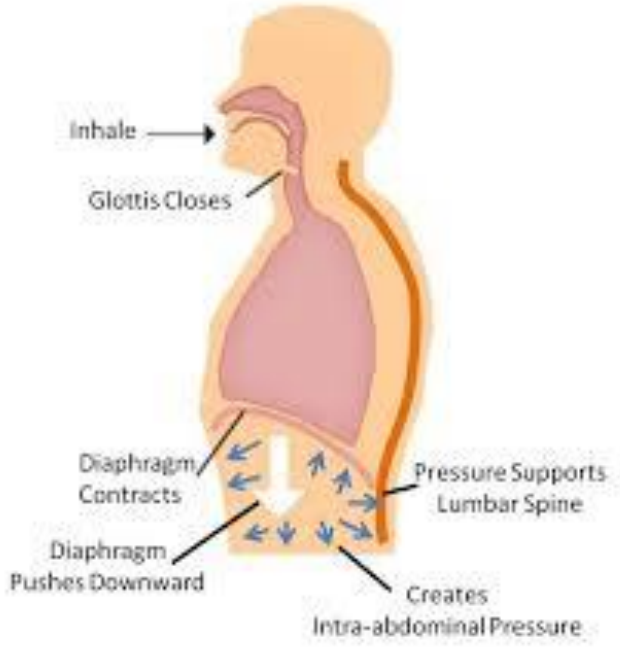
Defecation signals entering the spinal cord initiate other effects, such as:

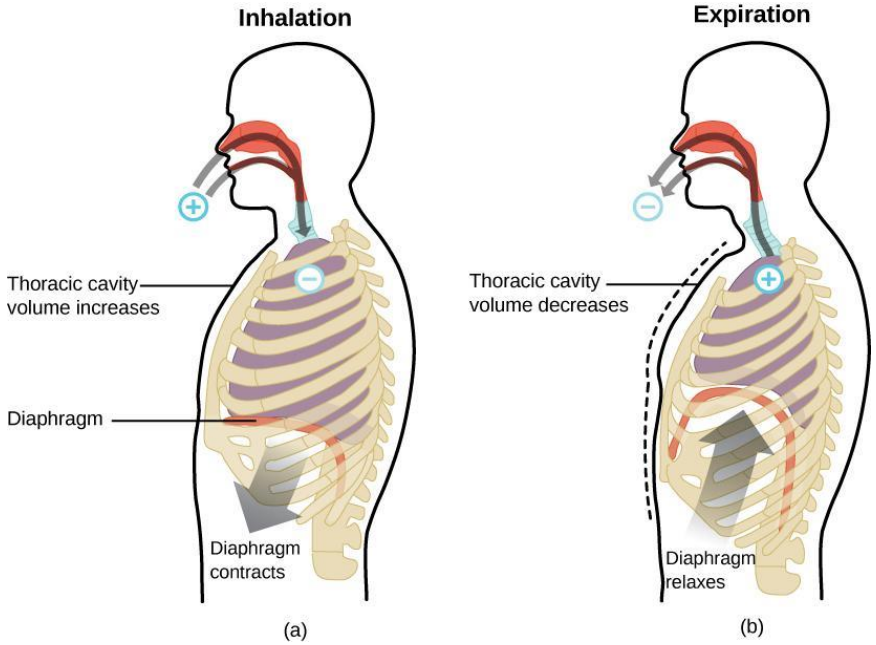
1- Taking a deep breath,

2- Closure of the glottis, and

3- Contraction of the abdominal wall muscles to force the fecal contents of the colon downward, and at the same time they cause the pelvic floor to relax downward and pull outward on the anal ring to evaginate the feces.

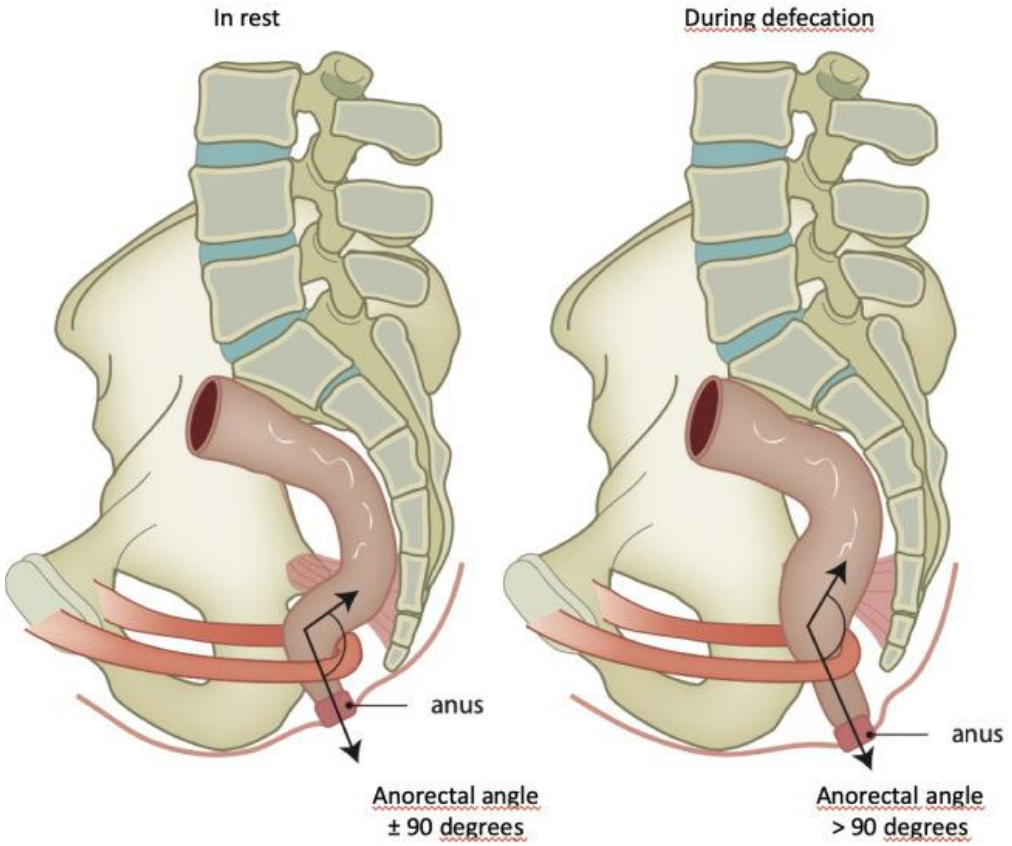
the defecation reflexes can purposely be activated by taking a deep breath to move the diaphragm downward and then contracting the abdominal muscles to **increase the pressure in the abdomen**, thus forcing fecal contents into the rectum to cause new reflexes.



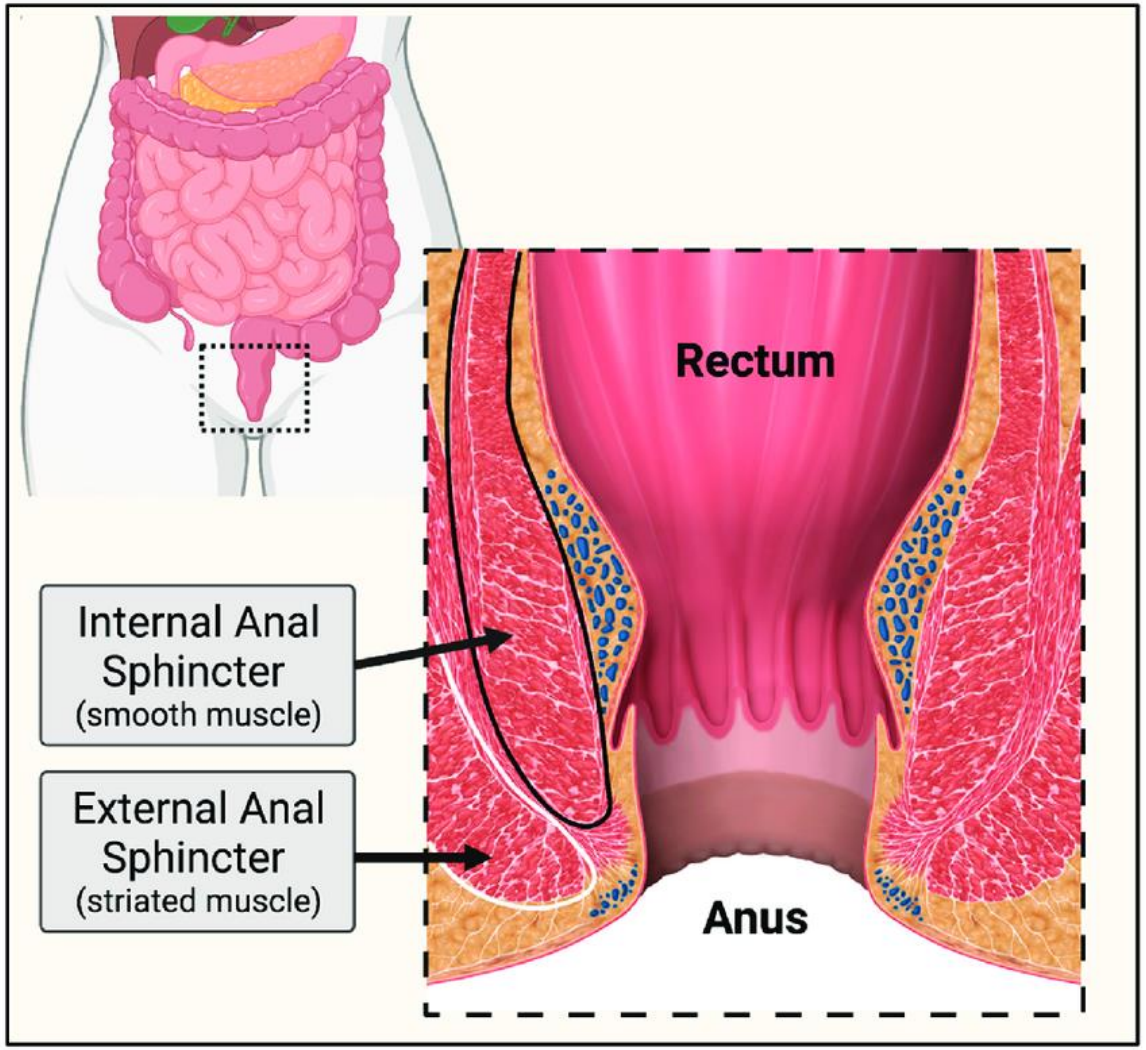


- **Normally, the angle between the anus and the rectum is approximately 90–100°** and this, added to contraction of the puborectalis muscle, inhibits defecation.
- **With straining**,
- the abdominal muscles contract,
- the pelvic floor is lowered 1–3 cm, and
- the puborectalis muscle relaxes.
- **The anorectal angle is straightened**,

and when this is combined with relaxation of the external anal sphincter, defecation occurs.



Defecation is therefore a spinal reflex that can be voluntarily inhibited by keeping the external sphincter contracted or facilitated by relaxing the sphincter and contracting the abdominal muscles.



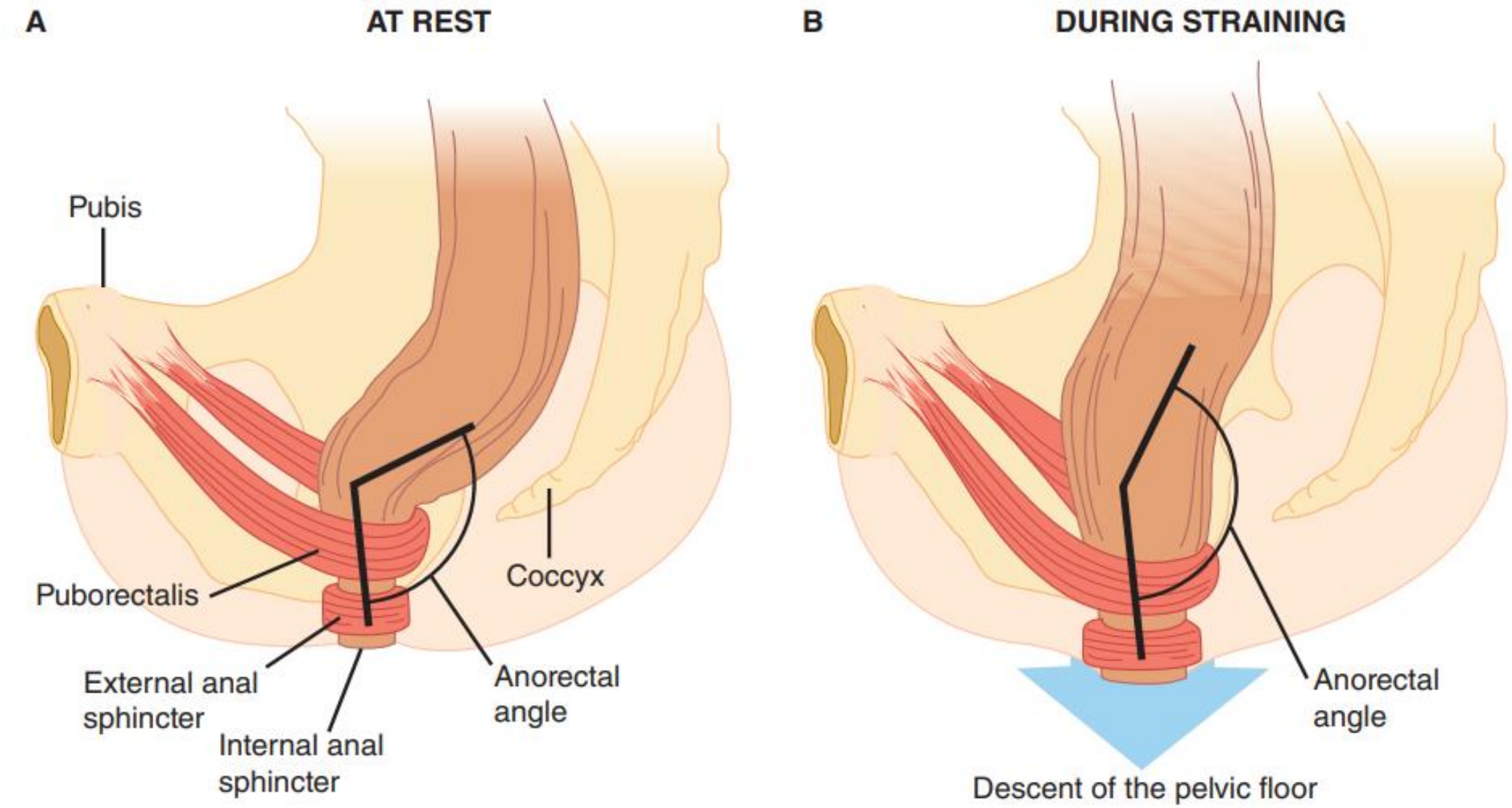


FIGURE Sagittal view of the anorectal area AT REST (A) and DURING STRAINING (B).

Note the straightening of the anorectal angle and lowering of the pelvic floor during straining.

CLINICAL APPLICATION

Diarrhea is characterized by excessive fluid excretion in the feces. Three different mechanisms:

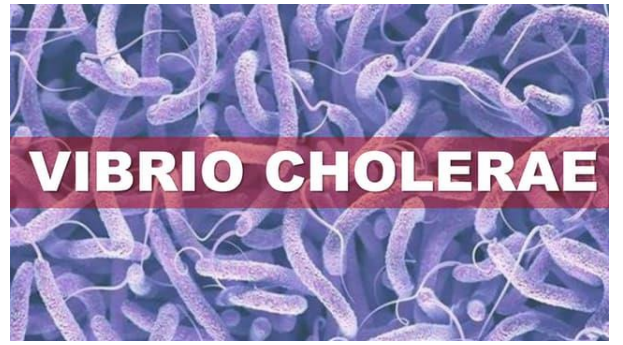
1- In cholera, severe diarrhea and dehydration result from enterotoxin, a chemical produced by the infecting bacteria. Enterotoxin stimulates active NaCl transport into the lumen of the intestine, followed by the osmotic movement of water.

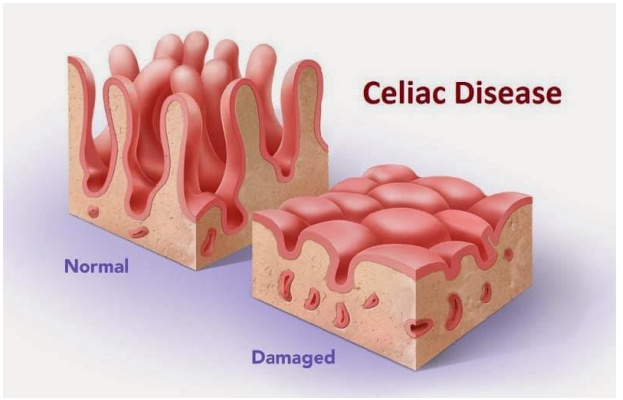
2- In celiac sprue, diarrhea is caused by damage to the intestinal mucosa by eating foods that contain gluten (proteins from grains such as wheat).

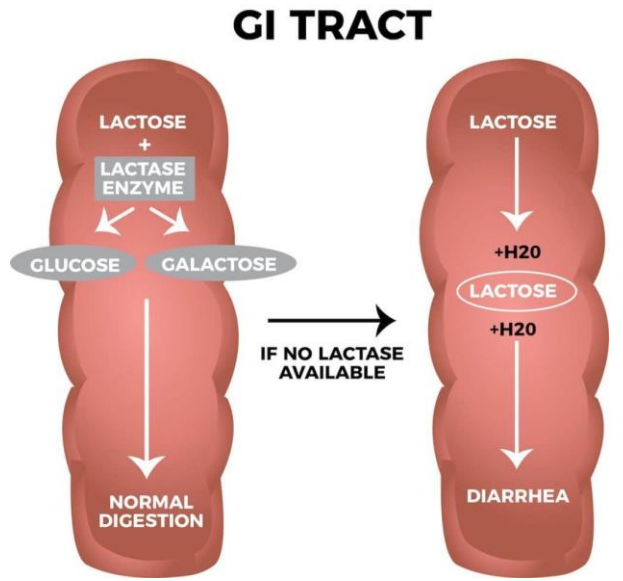
3- In lactose intolerance, diarrhea is produced by the increased osmotic pressure in the intestinal lumen as a result of the presence of undigested lactose in the gut and gets broken down by bacteria, causing gas, bloating, and diarrhea.

Lactose : a sugar found in milk and milk products







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