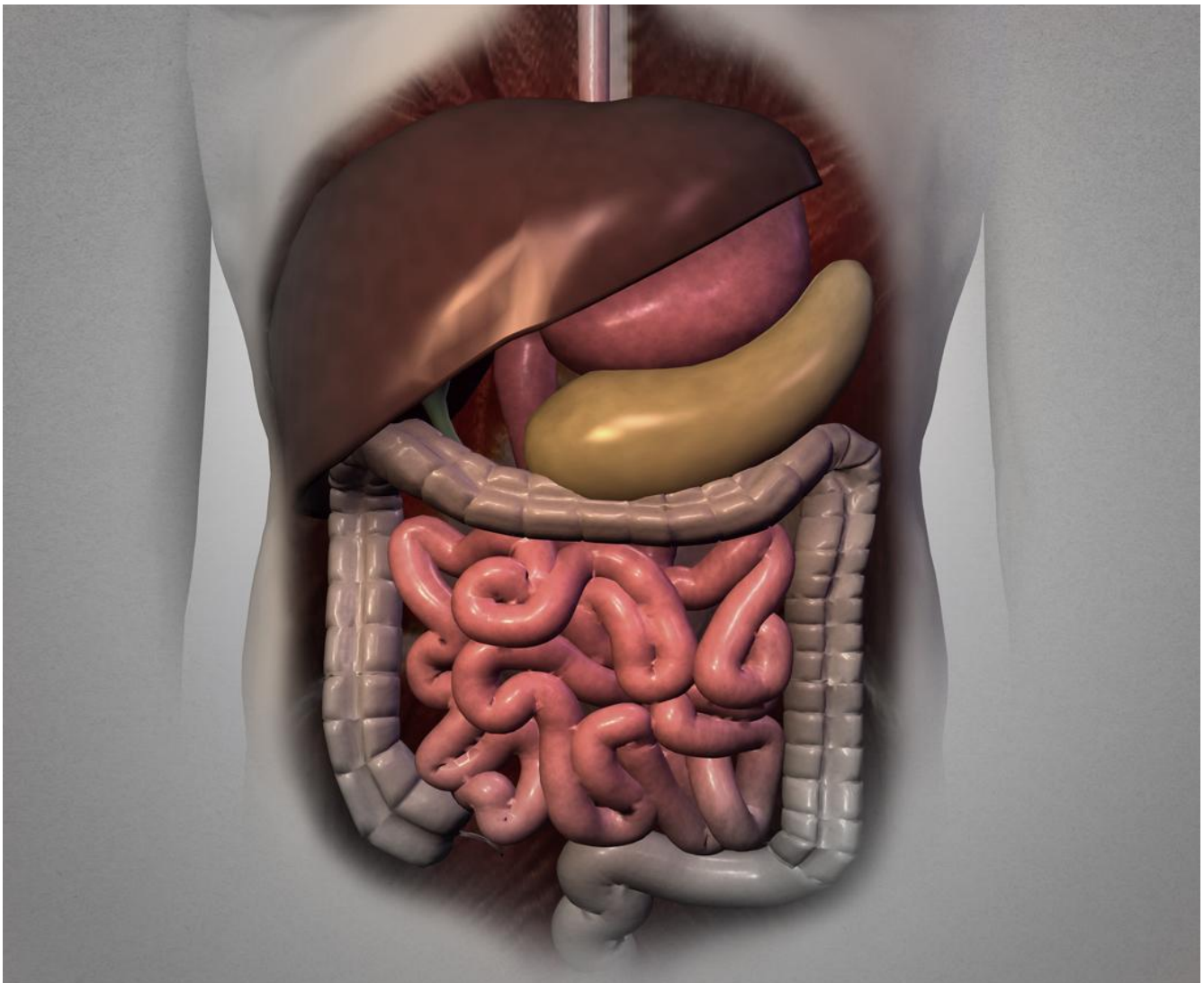

GIT Block

Physiology Team 431

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The Large Intestine

Parts of the Large Intestine:

1- Cecum

Saclike first part of the large intestine

2- Appendix

Accumulation of lymphatic tissue that sometimes becomes inflamed (appendicitis) and it hangs from the cecum

3- Colon

Ascending, Transverse, Descending and S-shaped sigmoid

4- Rectum

5- Anus .

The colon :

The outer longitudinal layer is modified to form three longitudinal bands called tenia coli visible on the outer surface.
Since the muscle bands are shorter than the length of the colon, the colonic wall is sacculated and forms haustra.

The mucous membrane of the colon lacks villi and has many crypts of Lieberkühn.
They consist of simple short glands lined by mucous-secreting goblet cells.
The epithelial cells contain almost no enzymes.
The colon has a length of 150 cm.
The transit of small labeled markers through the large intestine occurs in 36-48 hrs. ➔

It means that the digestive products will remain in the colon for around two to three days after the ingestion of food

food ingestion ➔ two, three days in colon ➔ defecation

Function of large intestine:

Absorb vitamins produced by bacteria .

Reabsorb water and compact material into feces .

Store fecal matter prior to defecation .

-The **ascending colon** is

specialized for processing Chyme delivered from the terminal ileum.

- When rediolabeled chyme is instilled (put gradually) into cecum, half of the instilled volume empties from ascending colon in 87 min
- This period is short in comparison with the transverse colon
- The ascending colon is not the primary site of storage, mixing and removal of water

- The **transverse colon** is

specialized for the storage and removal of water and electrolytes from feces.

- The labeled material is retained for about 24 hrs
- The transverse colon is the primary site for the removal of water and electrolytes and the storage of feces

- **The descending colon** is

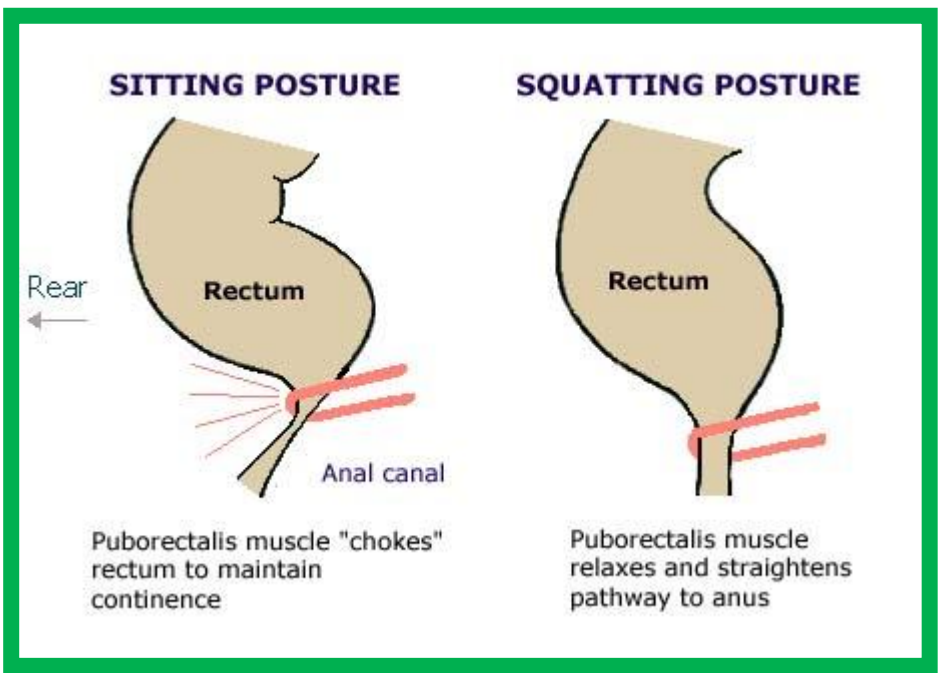
a conduit between the transverse and sigmoid colon, this region has the neural program for power propulsion that is involved in defecation reflex.

- **The rectosigmoid region, anal canal and pelvic floor musculature** maintains fecal continence**.** (They make the defecation process under voluntary control).

The sigmoid and rectum are reservoirs with a capacity of up to 500 mls; distensibility in this region is an adaptation for temporarily accommodating the mass movements of feces.

The puborectalis muscle and external anal sphincter comprise a functional unit that maintains continence .

Fibers of puborectalis join behind the anorectum and pass around it to form a U-shaped sling (physiological valve).



Secretion in the colon:

It is mainly mucus, no digestive enzymes.
The mucus has the following functions
1- It helps to lubricate feces.

2- It neutralizes against any acids present.

3- It protects against irritation.

4- It provides a binding medium for fecal matter

Stimulation of the pelvic nerves from the spinal cord can cause marked increase in mucus secretion, this occurs along with increase in peristaltic motility of the colon.

pelvic nerve =Distal part of the abdomen vagal neve = Proximal part of the abdomen

During extreme parasympathetic stimulation (pathological condition), so much mucus can be secreted into the large intestine that the person has a bowel movement of ropy mucus as often as every 30 minutes; this mucus often contains little or no fecal material.

Secretion of water & electrolytes:
Whenever a segment of large intestine becomes irritated as occurs in bacterial infection, the mucosa secretes large amount of water & electrolytes in addition to the alkaline mucus, this dilute the irritating factors and causes rapid movement of the feces toward the anus.

Absorption in colon

N.B= The large intestine can absorb a maximum of 5 to 8 liters of fluid and electrolytes each day.
Most of absorption in the colon occurs in the proximal half of the colon (absorptive colon), whereas the distal colon function for storage (storage colon). What is the function of each ?

1- Water absorption= 0.5 – 1.5 L \ day.
Water loss= 150-200 ml \ day.
2- **Na+ absorption**, is actively absorbed (in the presence of Na+-K+ ATPase) at the basolateral membrane to blood.

3- **K+** is secreted into the lumen of colon.

4- **Cl-** is absorbed in exchange for **HCO3-** which is secreted.

5- **Vitamins as Vit. K, biotin, B5, folic acid and some AA and short chain FA** resulting from bacterial fermentation of CHO are absorbed

6- **Certain drugs as steroids and aspirin** may be absorbed.

7- **Bile salts and organic wastes as urobilinogens and sterobilinogens** can be absorbed.

Bacterial action in the colon: Provide benefits to

This bacterial flora is living in symbiosis with human and its effects are beneficial to the body as follows:

①Synthesis of vitamin K and some B group vitamins as folic acid, biotin, thiamine and B12. The bacteria-formed vitamin K is especially important because the amount of this vitamin in the daily ingested foods is normally insufficient to maintain adequate blood coagulation.

②Deconjugation and decarboxylation of Bile salts.
Break down of bile pigments to produce stercobilinogen.

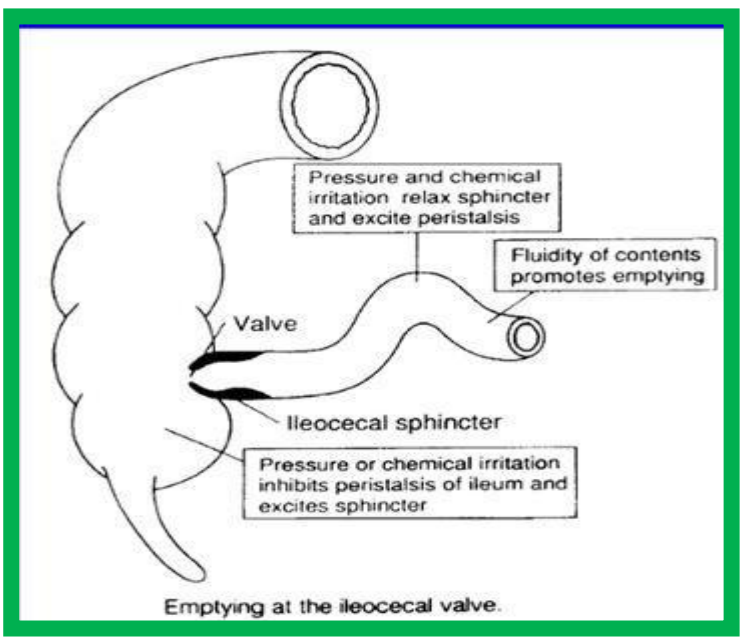
④Decarboxylation of some AA to produce amine and histamine. The amines are excreted in feces and are responsible for its smell.

⑤Break down of urea by bacterial urease to ammonia. Most ammonia is absorbed and reconverted into urea by liver. In hepatic failure, accumulation of ammonia can cause hepatic encephalopathy.

⑥Fermentation of undigested CHO.

The ileocaecal valve:

Function: It prevents backflow of contents from colon into small intestine.
It remains closed and open only when an **intestinal peristaltic wave** reaches it.
Stimulations that contract ileocaecal valve: Distension of the cecum, Secretin, Ach, alpha adrenergic.
Stimulations relax ileocaecal valve: Gastrin, CCK, and B adrenergic.



Emptying at the ileocecal valve.

Types of colonic movements:

1- mixing movement (Hustrations).
2- propulsive(mass) movement .
3- Antiperistaltic movement.

1- Mixing Movement (Haustrations) :

The motor events in the cecum and ascending colon

Large circular constrictions occur. At each of these constrictions points, 2.5 cm of the circular muscle contracts, at the same time the longitudinal strips contract. These combined contractions cause the unstimulated portion of large intestine to bulge outward into baglike sacs called **haustrations** .They also at times move slowly analward during their period of contraction. After another few minute new haustral contractions occur in other areas nearby. In this way all fecal material is gradually exposed to the surface of the large intestine & fluid is progressively absorbed.

2- Propulsive (mass) movement:

This is the motor events in the transverse and descending colon
These movements usually occur only few times each day, most abundantly for 15 min during the first hour after eating breakfast.

A mass movement is a modified type of peristalsis characterized by a constrictive ring occurs at a distended or irritated point in the colon. Then rapidly the 20 or more cm of the colon distal to the constriction contract almost as a unit forcing the fecal material en mass down the colon.

It start at the middle of transverse colon and is preceded by relaxation of the circular muscle and the downstream disappearance of haustral contractions

The initiation of contraction is complete in about 30 seconds. During the next 2 to 3 min another mass movement occurs. the whole series of mass movement will usually persist for only 10 min to half an hour. They will then return after a half day or even a day later . When they have forced a mass of feces into the rectum the desire for defecation is felt.

Irritation of mass movement:

Gastrocolic & duodenocolic reflexes after meals. They result from distension of the stomach & duodenum.

♣ Irritation of the colon e.g., castor oil.

♣ Intense stimulation of parasympathetic NS.

♣ Over distension of a segment of the colon .

3- Antiperstaltic:

It starts at the junction of ascending and transverse colon and traveling towards the cecum. It mixes contents and help water absorption.

Control of colonic motility

The intramural plexuses directly control the contractile behavior of the colon.

- **Stimulatory** enteric motor neurons use **acetylcholine & substance P** as neurotransmitters.
- **Inhibitory** enteric motor neurons release **VIP & NO** onto colonic smooth muscle cells.
- The extrinsic autonomic nerves to the colon **modulate** the control of the colonic motility by the enteric nervous system.

- **The rectum**: This region has sensory receptors of pain, temperature and touch

Last portion of the digestive tract that terminates at the anal canal.

- Mechanoreceptors in the rectum detect distention and supply the ENS.
- The anal canal in the region of the skin is innervated by somatosensory nerves that transmit signals to CNS.
- Contraction of anal sphincters and puborectalis muscle blocks the passage of feces and maintains continence .

Defecation:

It is **a spinal reflex** which is influenced by **higher center.**
Most of the time the **rectum is empty** and both **internal and external sphincters** are maintained in a state of **tonic contraction**.
Stimulation: Gastric or intestinal filling initiate a mass movement in the colon that pushes feces into rectum (Gastrocolic and duodenocolic reflexes).
The **rectum is distended** and sends signals to **cerebral cortex** producing the **desire to defecate.**

Defecation reflex : (IM)

1-Distension of the rectum.

2.Stimulation of the stretch receptors in the rectum.

3.
a) Short reflex: Stimulation of myenteric plexus in sigmoid colon and rectum.
b) long reflex: stimulation of parasympathetic motor neurons in sacral spinal cord.
c) Stimulation of somatic motor neurons.

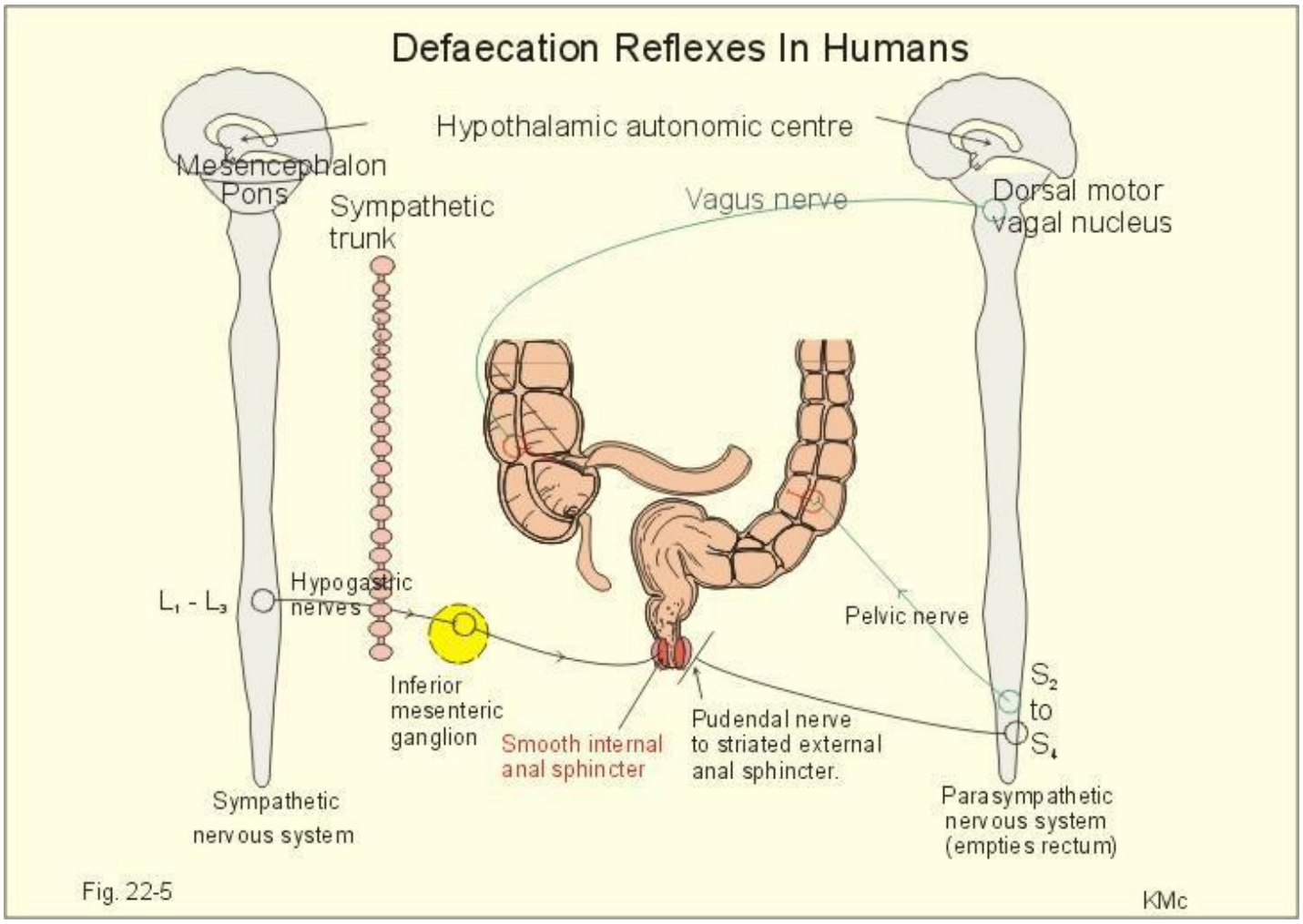
4.Increased local peristalsis. Relaxation of internal anal sphincter and contraction of external anal sphincter.

If the surrounding circumstances are suitable:

Defecation reflex will be **allowed. Stretch of the rectal** wall is signaled to SC by **pelvic nerve**, efferent pelvic impulses cause **reflex contraction of the rectum and relaxation of IAS**, this is followed by **reduction in tonic impulses to EAS,** so it relaxes and **feces leave the rectum** assisted by **voluntary straining** and contraction of pelvic floor muscle.

If situation is not suitable for defecation:

The reflex is **inhibited** by the cerebral cortex.
Tonic contraction of EAS is voluntary maintained which leads to accommodation of the **rectum to distension** and return of **tonic contraction of the IAS.**
In infants (and in spinal cord lesion) the spinal reflex of defecation operates **without** interference from **higher centers (fecal incontinence).**



Summary:

Role of colon : function depend on the location :
Ascending colon : processing of chyme coming from ileum .
Transverse colon : Absorption of water and electrocytes and storage of faces .
Descending colon : to conduct feces from Transverse colon to sigmoid rectum (involved in defecation reflex)
- Secretions of large intestine:
Mucus by Goblet cells (in crypts of Leiberkuhn) ..
NO ENZYME SECRETION in large intestine

- Factors increase propulsive movements :

1-Gastrocolic reflex : a reflex takes place from stomach to terminal ileum after taking a meal >> more chyme will enter ascending colon >> distention of colon >> increase propulsive movements
2- Irritation of colon wall (e.g. castor oil)

Defecation reflex :

Stretching of rectum will initiate three reflexes :

1- Short reflex : stimulation of myenteric plexus (ENS) in sigmoid colon and rectum >> increase local peristalsis

2- long reflex : higher center stimulation by parasympathetic motor neurons from sacral spinal cord >> increase peristalsis throughout large intestine and relaxation of internal anal sphincter >> feces will move through anorectal canal

3- Stimulation of somatic motor neurons (voluntary) >> contraction of external anal sphincter (controlled by Pudendal nerve)

Note : Finally these reflexes will cause defecation by : Increased local peristalsis, Relaxation of internal anal sphincter and contraction of external anal sphincter .

Questions:

It is a distinctive feature of the large intestine:
A- Caecum
B- Teniae coli
C- Appendix
D- None

The bacterial flora in large intestine synthesize?
A- Vitamin C
B- vitamin K
C- vitamin A
D- None

Which one of the following will contract the iliocecal valve:

A- Gasrin.

B- secretin

c- VIP.

D- CCK