



الجزي



# GI system

Physiology

Sheet

Slide

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In the last lecture we talked about segmentation contractions, peristaltic contractions.

Migrating motor complex contractions (MMC); know that these motor movements occur between the meals. When the gastro intestinal tract is empty and evacuated everything and another wave of contraction began from the stomach travelling to the small intestinal until the ileocecal part → this is to sweep the content and remove everything out i.e. (emptying of the small intestine). It is believed that the initiation of these motor activities is by a hormone that is called motulin.

Don't worry about the relation between MMC and the electrical activity.

Peristaltic rush: peristaltic contractile activity becoming very intense in the small intestine due to an underlying pathological condition. The treatment is to remove the causative agent. This causes diarrhea due to the high intestinal activity, especially watery diarrhea. In such a situation try to avoid anti-diarrhea drugs, this is to let the intestine clean itself by the diarrhea and simply give the patient fluids to avoid dehydration. If the diarrhea continues after 2-3 days then you can give drugs that reduce the diarrhea (not abolish).

Muscularis mucosa, which is present in the junction between mucosa and submucosa, is important for the movement of the chyme over the mucosa. The mucosa is not static, it's always moving and the muscularis mucosa increases the spreading of the chyme over the mucosa to improve the absorption.

The intestinal contractions are overall controlled via three ways:

- I- The rhythmic activity controls the basal contractions of the circular layer and part of the peristaltic contractions (the longitudinal layer) as previously mentioned. A constant rhythm of the slow waves (see previous sheet), which is almost equal along the entire GI tract, is present. In the lab we'll monitor a small region of the upper part of the small intestine which has a higher rate of contractions than the lower part of the small intestine.
- II- Part of the peristaltic contractions and relaxations are controlled by the enteric and the autonomic nervous systems.

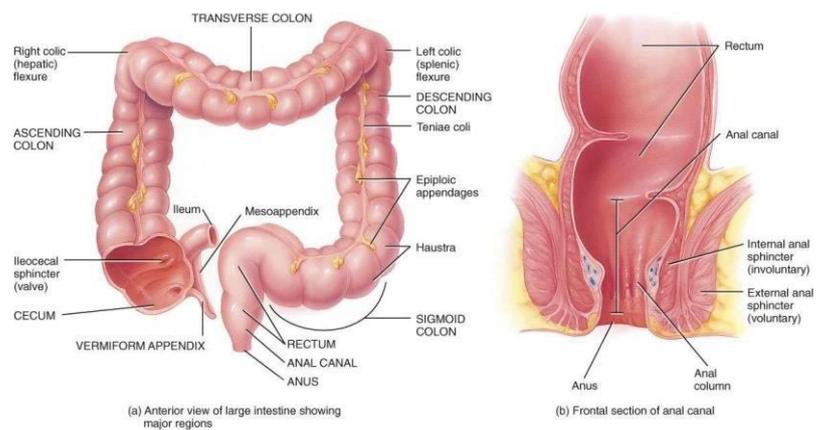
III- Hormones, like gastrin, cholecystokinin, serotonin (enhance motility), secretin and glucagon (inhibit motility), play a minor role in the control of intestinal contractions.

### Activities at the Level of the Colon

#### *Haustration contractions and Mass contractions.*

Anatomically, if we are viewing the colon we will see that at a certain point the circular muscular layer will be contracted and at the following point it will be relaxed and so on. In the next moment, the relaxed point will contract and the contracted point will relax. This is a similar activity to the segmentation contractions of the small intestine, but, due to the structural variation between large and small intestines, the results are slightly different.

In the small intestines, the longitudinal muscular layer is present all over the small intestines, but in the colon (see the diagram as you read) you will have a higher representation of the muscles of the longitudinal layer forming strips at the upper part, the lower part and posteriorly. These three strips, which are layers of the smooth muscle cells, move together to form the tinea coli. Because of the high activity of these layers and the circular layer, the result of the segmentation is more evident forming bulges called haustra (see diagram) and so these contractions are called haustration contractions instead of segmentation contractions.



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At the level of the colon, there is no need for mixing of the contents of the chyme, therefore, the haustration contractions have a propulsive effect. But, these contractions are very weak such that you need 7-9 hours for the fecal material to move through the ascending colon to the transverse colon! However, this time is not useless, it is utilized in reabsorbing of water and electrolytes.

In the transverse colon, the fecal material become semi-solid instead of semi-liquid, this means that we need more force now to move the fecal material and here comes the role of the mass contractions.

These mass contractions are seen as motor activities of the longitudinal and the circular muscles, but they are not present all the time, in fact, mass contractions are only seen twice or thrice daily and each time lasts for 10-30 minutes and these contractions appear mainly in the first hour after breakfast.

The mass contractions are initiated by gastrocolic and duodenocolic reflexes. These reflexes are activated autonomically after you have eaten activating the transverse colon and the mass contractions.

In the mass contractions the fecal material are moved towards the descending colon and the sigmoid. In the descending colon and the sigmoid distinction, the intrinsic defecation reflexes, from the name (intrinsic) which nervous system do you expect it to be responsible for this reflex? the enteric nervous system.

This results in more powerful motor contractions resulting in more distinction which activates the extrinsic defecation reflexes (the autonomic (parasympathetic here) nervous system by activating the sacral fibres, remember that the upper part was innervated by the vagus nerve).

The motor movements are fortified and more powerful movements are achieved, but this will not necessarily result in defecation as there are sphincters. The internal sphincter begins to relax in response to the extrinsic reflexes, but this is still not enough for defecation as there is still the external sphincter which is under the voluntary control.

Even with voluntarily relaxing the external sphincter sometimes that won't be enough for defecation and the intra-abdominal pressure has to be raised (voluntarily) for defecation to occur.

### *Constipation and Diarrhea*

The diarrhea can result due to the hyper-activity of the colon or the small intestines. If the hyper-activity is at the level of the small intestine the diarrhea will be watery. If the problem is at the level of the colon then the patient will not be able to defecate a lot of feces due to the mucus nature of the secretions of the large intestines resulting in a "feeling of diarrhea" with the presence of mucous diarrhea which results in only a small amount of feces being defecated.

Hypo-motility of the colon (remember the condition in the esophagus in which there was a small representation of the enteric neurons in the esophagus, here it is similar) may result in the dilation of the colon due to the accumulation of the fecal material there and this condition is

called “Mega-Colon” or “Hirschsprung’s disease”, this disease can result from the reduced representation of the neurons of the enteric nerves system in the colon and this disease is mainly associated with constipation.

Hyper-active neurons can result in an irritable bowel. This hyper-activity is sometimes related to the over-production of some excitatory neurotransmitters. The neurons are not only related to the motility of the colon, they also result in some pain sensation resulting in the patient beginning to feel pain.

### Secretions of The GI Tract

There are many secretory cells in the GI tract beginning from the oral cavity itself.

As you know, in the oral cavity we have the salivary glands which secrete saliva and in the esophagus we have some secretions like mucus.

It’s important to differentiate between serous secretions and mucous secretions. Mucous secretions are mucin rich → mucin is a glycoprotein. Serous secretions, on the other hand, are more watery and more rich with electrolytes.

Then in the stomach where we have around 2L of gastric juice released per day. In the small intestines we have around 1L of intestinal juice released per day. The liver releases around 1L of bile per day. Even the pancreas, which is a small organ, releases around 2L of fluids per day, that’s around 5 times of its weight.

So, in the entire GI tract we have secretions that reach around 9.3L per day. These secretions are not lost, most of them are reabsorbed especially in the lower part of the small intestine (about 85%), then in the colon (around 10-15%). We recover around 9.2 L of those fluids and lose around 0.1L with faeces.

As you know, we need a media for the reactions to occur which is provided by the secretions. Also, they contain enzymes that are important for the reactions. Furthermore, mucous secretions have a lubricative role (mucous secretions are found the most in the esophagus and the colon. In the esophagus we ingest solid materials so mucous is needed to protect the mucosa and in the colon the fecal material is also solid so mucous is needed there too).

The secretory cells can be single cells or can be organs, there are also pits and complex glands (in the submucosa).

Generally, we have a powerful control over the secretions involving the autonomic nervous system, some hormones (e.g. gastrin, cholecystokinin, secretin) and the enteric nervous system.

Generally, the parasympathetic system increases the secretions while the sympathetic decreases them. Some literature say that moderate sympathetic stimulation result in some increase in the secretions and that higher sympathetic stimulation results in inhibition (of course parasympathetic results in increasing the secretions).

What the sympathetic system does is that it activates the vesicular transport, so if we need to increase the vesicular transport (like mucous) we might get some increased secretions on the way. "this way moderate sympathetic activation increases the secretion"

Viewing it from another angle, the sympathetic system has a high effect over the blood flow and once there is vasoconstriction the available fluids for the secretory cells decrease and so do the secretions.

So overall, just know that the sympathetic system decreases the secretory activity.