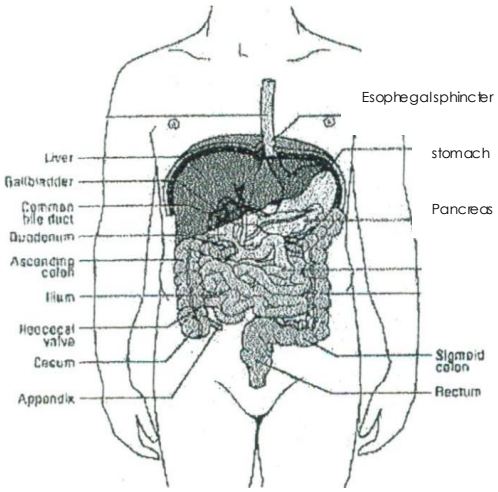
Digestion: How It Works and The Approach to Treatment

The Digestive Process

Digestion is the process by which foods are prepared for absorption. It has several stages that are largely sequential, meaning that they must occur in order to be optimal.



The stages are:

1. **Chewing** – a gross breakdown in the structure of food, but one that can be very important. There is minor enzymatic (molecules secreted which break down food at the molecular level) action here from the saliva. The real importance of chewing is that taste, smell and the action of chewing start a cascade of preparatory steps from the digestive organs down the line through the nervous system and the endocrine system (hormones and other chemical messengers). In World War II, there was a doctor interned at a camp who was the man responsible for his barrack. In order to keep as many alive as possible, he awarded half of his portion of bread to the prisoner that chewed his own bread the longest. In this fashion, 100% of his men survived. No other group had a survival rate of this nature. By chewing, the men prepared their bodies optimally for what was coming next.

2. **Acidification**- The only job of the stomach is to acidify. We ingest food at a pH of around 7 (the pH of water, which is neutral) and the stomach brings it down to below the acidic pH of 2. pH is a log scale, so for every digit up or down it is 10X as acidic or basic. The stomach, therefore, has to acidify the contents of the food by about a million times, producing a fluid known as chyme.

   The stomach acid primarily breaks down the gross structures of proteins. Most proteins are large, bunched up chains of amino acids that are folded, refolded and attached to each other. It is a lot like a length of yarn, which we could say is like the amino acid chain, firmly bonded end to end in a string, folded up onto itself and then attached by weak bonds like Velcro to other chains. The acid in the stomach helps to break these weak bonds and some of the folding structures, like unwinding a ball of yarn. Once you have the yarn, the protein chain is ready for enzymatic breakdown, which occurs primarily in the next steps of digestion.

Points Relevant to Therapy

Only a few things really modify the stomach's ability to acidify:

- **Stress** – decreases stomach acid. This is probably one of the main mechanisms for stomach symptoms under life stress.
- **Dehydration** – the stomach acid is made up of water and hydrochloric acid components (hydrogen ions and chloride ions). If there is a deficiency of water or of salt compounds, stomach acid will be limited in production. Sometimes, individuals will complain that they feel very full, heavy and sleepy after eating. This is typically the result of the body finding water from elsewhere in the body to use for digestion, and this affects the most water using structures, including the brain!

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Symptoms Related to Errors of Stomach Function:

- **Heartburn**- heartburn is when the stomach contents are irritating the sphincter or valve to the esophagus (swallowing tube). This typically happens because the stomach is having trouble acidifying the contents of the stomach completely. The second sphincter on the stomach at the exit end is pH sensitive. It will not open completely unless the acidification is reasonably complete. Therefore, the stomach, contracting to mix the food, can push mildly acidic food up near the esophageal sphincter. This burns because it is more acid than the surface of the esophagus.
- **Heavy Feelings Post Eating**
- **Pain –** in the area at the bottom of the sternum, sometimes escalating into a feeling that is interpreted as heart pain or an anxiety attack.
- **Burping** – or when you can taste the food you ate hours ago.
- **Ulceration** – including the appearance of black, tarry stools.

3. **Bile and Pancreatic Enzyme Action** – the level of acidification in the stomach stimulates a set of chain reactions to occur a little farther down the line in the duodenum and associated organs. The duodenum is the region of small intestine that is attached to the stomach. The tubes from the gallbladder, liver and pancreas excrete into this region. The pH of the stomach contents coming into contact with the wall of the duodenum causes a proportional secretion by the pancreas of an alkaline fluid containing digestive enzymes. The lower the chyme pH, the more pancreatic fluid is secreted. The fat content of the stomach contents stimulates the contraction of the gallbladder, which contains bile secreted from the liver. So, the action of the pancreas and gallbladder are dependent on what comes out of the stomach.

   The pancreatic juice neutralizes the acid coming out of the stomach with a compound that is pretty much like baking soda. The enzymes that are secreted from the pancreas are proteases, lipases, and saccharidases . They help digest proteins, fats and carbohydrates respectively by breaking the molecular bonds of these substances. In the case of protein represented by the piece of yarn, using protease would result in the yarn being cut into shorter lengths of amino acids.

   The bile is the product of the *liver*. It serves two main purposes. The liver incorporates waste products that it has detoxified in the bile (more about the liver later) The waste products found in bile are a range of different compounds such as hormones, environmental toxins and waste from the normal processes of metabolism. It also secretes bile salts, which emulsify fat The emulsification of fat is the process whereby fat globules are broken up into small droplets more accessible to fat digesting enzymes that can break up the fat at the molecular *level* (similar to the way the stomach acid unwinds proteins so that protein digesting enzymes can get at the bonds).

   So, basically, the actual digestive process is completely prepared and initiated by the stomach and the first short section of the small intestine – the first foot and a half of tract.

Points Relevant to Therapy

- **Poor stomach function** will lead to poor response from the gallbladder and pancreas.
- **Poor liver function or pancreatic function** will lead to changes in bile or pancreatic fluid which may make digestion more difficult.

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Symptoms Related to Errors in Duodenal Function:

- **Trouble with fat or greasy food** – indicates a weakness of gallbladder function, an insufficient stimulus to the gallbladder or poor bile quality.
- **Maldigested food** appearing in the stool – if the breakdown of food is not occurring optimally, we know that the pancreas is not being stimulated appropriately.
- **Unusual stool consistencies** – will often be indicators of trouble high up in the digestive tract.

4. **Absorption and Immunological Screening**
The rest of the digestive tract is all about two things: absorption and immunity.

Properly prepared foodstuffs with all of the digestive juices added continue along the digestive tract, with the enzymes busily continuing to break down the food and allowing the lining of the small intestine to absorb them. There is a surface area of about the size of a tennis court in the adult human (this decreases in diseases where there is damage to villi structures, such as celiac disease). Absorption takes place through a layer of gut cells that transfer the digestive products into the blood stream. From here, the absorbed products are taken through the portal circulation to the liver, where they can be sorted as nutrient, toxin or information about the outside world. The digestive tract, although it digests, is also the largest immune organ in your body. There is more immune tissue (called Gut Associated Lymphoid Tissue or GALT) scattered down the digestive tract than is collectively found in the rest of the body combined. The gut wall is actually, if you think about it, completely exposed to the outside world. As such, its most important function is to protect you from threats from the outside. Because immunity is such an important function in this organ, it is not uncommon for gut symptoms to results from the action of the immune system attempting to protect you from a perceived threat.

Such threats can include:

- **Spoiled food** – rancid or poor quality foods
- **Micro-organisms** – viruses and bacteria from contaminated foods or from upper respiratory
- **Poor products of digestion** – if the digestive process has not gone well, the products available for absorption will be abnormal and this is often irritating to the gut.
- **Foods that you are allergic** to or have genetically determined sensitivity to – these types of food items will trigger direct immune responses
- **Food Intolerance** – where there is a product that you cannot digest.

The immune system is designed to react to proteins. Proteins are chains of amino acids that are directly read off of the DNA of a plant or animal. For this reason, some proteins are very similar from plant to plant or animal to animal. However, some of the proteins will be genetically unique. As a result, the immune system will often recognize them as foreign, and may interpret their foreignness to be a threat to your survival. If this is the case, the immune system will begin to manufacture antibodies or cell types that have the job of recognizing and attacking or eliminating the specific foreign protein (known as an antigen) that it perceives as a threat. If such mechanisms are present and that foreign antigen shows up, the immune system responds with both the specific mechanisms against that antigen and non-specific defenses, such a inflammation (see the food allergies handout). Typically, an appropriate immune response would use both of these methods and then the body would "reign them in", in effect creating an inflammatory response followed by an antigen specific response, followed by a cleanup of the original inflammation. If, however, the reaction is chronic or if the foreign protein is constantly being presented by the digestive process to the immune system, long term inflammation and damage to the gut wall can result.

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The gut wall, as I mentioned before, is a tightly knit sheet of cells that are held together by a cell structure known as a tight junction. It is designed to permit passage of molecules only through the cell wall or the GALT (Gut Associated Lymphoid Tissue), as opposed to directly into the blood. If the gut wall is damaged, a "leaky gut" can result, where digestive products and debris can enter the circulation without going through the screening process, similarly to how blood oozes out of the capillaries to form a bruise when you've hit your arm hard enough to create local inflammation.

The maintenance of this wall is dependent on having a regular repair and regeneration since the turnover of the gut cells is this layer can be as short as 24 hours. A significant number of normal bacteria live closely associated with the gut wall- about 3 pounds worth in an adult human. These bacteria contribute a great deal to the health and normal function of the intestine by out-competing pathogens for space and resources and doing metabolic reactions that the human cannot do (eg. Synthesis of Vitamin K). They do, however, need to be adequately fed by what is coming down the digestive tract. If the digestion is poor, or the lining is inflamed, normal bacteria may not get what they need to survive. This opens up the way for pathogenic bacteria or yeast to colonize.

Therefore, if there is something that the gut wall is having trouble dealing with, inflammatory damage can result which impedes normal digestion, creates inflammatory symptoms and requires more nutrients to adequately handle.

Points Relevant to Therapy

- **Poor duodenal function** will create abnormal conditions in the intestinal absorption process, primarily inflammation. Inflammation is partially corrected by:
    - **L-glutamine** – this is a non-essential amino acid that is the primary fuel of the gut cell for regeneration and repair. Using this assists the gut to repair itself.
    - **Borage oil**- this is a seed oil with a high concentration of gamma-linoleic acid, which is one of the nutrients that is crucial in the maintenance of tight junctions. Healing tight junctions makes the barrier less leaky.

    - **Acidophilus/Bifidus/Lactobacillus** – there are a number of normal flora organisms that can be placed into the digestive tract. It used to be thought that by doing this, we re-populated the gut. It is more likely that as these organisms pass through, as long as they are still alive, they produce metabolic by-products that feed the colonies already established. Herbal remedies can be used to decrease the populations of abnormal bacteria, similarly to antibiotics. If you can reduce the population enough, the immune system can often get the infection under control in its usual manner. However, direct killing of bacteria/yeast rarely solves the overall problem that created the numbers of abnormal bacteria to rise, since that has more to do with the overall health of the digestive process and immunity.

      Plus many more- Remember that an inflamed gut does not serve the purpose of absorbing nutrients well. Most individuals with long term gut issues suffer from a myriad of nutritional deficiencies. Sometimes the deficiency is the presenting symptom. Often there is bleeding from the gut that occurs since the blood capillaries are so close to the surface of the gut wall.

    - **Immune stimuli** can be at the root of a small intestine malfunction and can be exacerbated by the above. An immune reaction can be controlled by:
        - Identifying food sensitivities and intolerances – often these are at the base of gut symptoms. Removing the immune instigator is one of the most effective strategies to give the gut enough latitude to heal itself.

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Symptoms Associated with Poor Small Intestine Function

- Anemia/malabsorption symptoms – anemia is sometimes the presenting complaint to a serious gut disease.
- Bloating with meals or at irregular intervals
- Rashes or asthma aggravations
- Diarrhea/constipation

5. Stool Formation

The colon is the end stretch of intestine. It is designed to absorb water from the digestive mixture that has reached it. This creates a formed stool. The bulk of the stool is made up of indigestible fibers, bacteria (almost a third!) and waste products. A lack of the first two elements often is responsible for an insubstantial stool.

Answer to Other Questions that Are Frequently Asked By Patients

Where does pain come from in the gut?

Inflammation – pain can result when an inflamed part of the gut wall is brushed up against by food combined with its normal contraction. This is like constantly moving a bruised limn. It can also result from inflammatory compounds released in response to an immune challenge- they create direct pain in the tissue. This could be likened to the pain of arthritis in a joint. Overwork – when the gut has to constantly contract against an abnormal stool consistency, it can be subject to pain from over contracting just like a limb. If there is a little bulk in the stool, the tube can be trying to grip and move too small of an object. If the stool is hard, there may be the frustration of trying to move a stool without enough lubrication. These can all create pain. Trapped gas – if there is significant flatulence, this may create pain by stretching the gut too wide. This is like pulling the sides of the mouth out with the fingers until it hurts.

Where does abdominal bloating come from?

Inflammation! Too much trapped stool – the gut can be literally full from end to end with stool.

What is diarrhea?

Diarrhea is a stress response from the gut – it is attempting to get rid of something that is irritating it. This is why you often see diarrhea when there is an acute bacterial or viral threat. The body is attempting to decrease the load of organisms.
Chronic diarrhea creates dehydration and nutrient loss, and is a sign that the gut is chronically irritated.

What is constipation?

Constipation can be many things. Typically, the most common causes are:

- Dehydration
- Attempt by the body to obtain more nutrients by slowing down the stool passage and create more time for absorption

Taking the Understanding of the Gut Wall One Step Further - Long-term Matrix Issues

Over the long run, a damaged gut can accumulate a great deal of debris in the mesechymal or matrix tissue. In short, this connective tissue layer is the buffer between organ cells such as gut enterocyte of lining cell, and the blood stream. Over time, this space can collect debris that must be moved out for full function to return. See the handout on Biological Medicine for further explanation. Specific remedies can be used to help the mesenchymal space to return to normal.

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