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Gastrointestinal Motility Disorders of the Small Intestine, Large Intestine, Rectum, and Pelvic Floor

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Normal Gastrointestinal Motility and Function

"Motility" is a term used to describe the contraction of the muscles in the gastrointestinal tract. Because the gastrointestinal tract is a circular tube, when these muscles contract, they close off the tube or make the opening inside smaller – they squeeze. These muscles can contract in a synchronized way to move the food in one direction (usually downstream, but occasionally upstream for short distances); this is called peristalsis. If you looked at the intestine, you would see a ring of contraction that moves along pushing contents ahead of it. At other times, the muscles in adjacent parts of the gastrointestinal tract squeeze more or less independently of each other; this has the effect of mixing the contents but not moving them up or down. Both kinds of contraction patterns are called motility.

The gastrointestinal tract is divided into four distinct parts: the esophagus, stomach, small intestine, and large intestine (colon). They are separated from each other by special muscles called sphincters, which normally stay tightly closed and which regulate the movement of food and food residues from one part to another. Each part of the gastrointestinal tract has a unique function to perform in digestion, and as a result each part has a distinct type of motility and sensation. When motility or sensations are not appropriate for performing this function, they cause symptoms such as bloating, vomiting, constipation, or diarrhea that are associated with subjective sensations such as pain, bloating, fullness, and urgency to have a bowel movement. This article describes the normal patterns of small and large intestine motility and sensation, along with the symptoms that can result from abnormal motility or sensations.

SMALL INTESTINE

Normal Motility and Function

The parts of the small intestine are the duodenum, jejunum, and ileum, but these three areas of the small intestine all have the same general function, namely the absorption of the food we eat. During and after a meal, the intestine normally shows very irregular or unsynchronized contractions that move the food content back and forth and mix it with the digestive enzymes that are secreted into the intestine. These contractions are not entirely unsynchronized; they move the contents of the intestine slowly towards the large intestine. It normally takes about 90–120 minutes for the first part of a meal we have eaten to reach the large intestine, and the last portion of the meal may not reach the large intestine for five hours. This pattern of motility is called the "fed (or eating) pattern."

Between meals, the intestine shows cycles of activity that repeat about every 90–120 minutes. These are easiest to see at night when there is a longer period between meals, because meals suppress these cycles. The cycle consists of a short period of no contractions (Phase I), followed by a long period of unsynchronized contractions that appear similar to the fed pattern (Phase II), and then a burst of strong, regular contractions that move down the intestine in a peristaltic fashion (Phase III). Phase III represents a continuation of the "housekeeper waves" that start in the stomach; its function is to sweep undigested food particles and bacteria out of the small intestine and into the large intestine.

There are two other kinds of motility seen in the small intestine, but their function is not as well understood. Discrete clustered contractions are brief bursts of contractions (each burst lasts only a few seconds) which are synchronized (peristaltic). They occur mostly in the upper small intestine and fade out before moving too far downstream. They occur in most people at infrequent intervals, but in patients with irritable bowel syndrome they may be associated with abdominal pain.

The second type of contraction is the giant migrating contraction. This occurs primarily in the lower small intestine (ileum), and it is peristaltic over long distances. It may be part of a defensive reflex that sweeps bacteria and food debris out of the intestine. These giant migrating contractions occur in healthy people and usually cause no sensation, but in patients with IBS they are frequently associated with reports of abdominal pain.

Intestinal Dysmotility, Intestinal Pseudo-obstruction

Abnormal motility patterns in the small intestine can lead to symptoms of intestinal obstruction (blockage). These symptoms are bloating, pain, nausea, and vomiting. They vary in how severe or how frequent they are, but there are usually periods during which the patient is free of symptoms. These symptoms can result either from weak contractions or from disorganized (unsynchronized) contractions.

Weak contractions of the small intestine are due to abnormalities in the muscle and are usually associated with diseases such as scleroderma. These connective tissue disorders may cause the intestine to balloon out in places so that the contractions of the muscle are not able to move the contents downstream. Other patients have contractions that are strong enough, but they are too disorganized or non-peristaltic to move food along. This type of motility disorder is due to abnormalities in the nerves, which coordinate

(synchronize) the contractions of the intestine. This abnormality is easiest to detect by recording the housekeeper waves because these are easily identified peristaltic contractions. In intestinal pseudo-obstruction of the neurological variety, these bursts of contractions occur simultaneously over large parts of the intestine or they may actually move upstream.

The test that is used to detect either of these intestinal motility abnormalities is a small bowel motility study. This involves placing a long tube with pressure sensors on it that passes through the stomach and into the small intestine. It is important to record several of the housekeeper wave fronts to be sure of the diagnosis. In some clinics this is done by recording for five hours or more while the patient lies on a bed in the clinic, but in other clinics, the pressure sensors are connected to a battery-operated computer and the patient is sent home to return the next day.

Small Bowel Bacterial Overgrowth

This means that there are too many bacteria in the upper part of the small intestine. This leads to symptoms of bloating, pain, and diarrhea that occur immediately after eating because the bacteria in the intestine begin to consume the food in the small intestine before it can be absorbed. These bacteria give off hydrogen and other gases which cause bloating and diarrhea. Small bowel bacterial overgrowth is a result of abnormal motility in the small intestine; when the housekeeper waves do not keep the bacteria swept out because the contractions are too weak or disorganized, the bacteria grow out of control.

Bacterial overgrowth is most easily detected by the hydrogen breath test: The patient drinks a sugar solution and breathes into a bag every 15 minutes for two hours. If the bacteria are present in large amounts in the small intestine, they give off hydrogen, some of which is absorbed into the blood, carried to the lungs, and breathed out where it can be detected.

LARGE INTESTINE (COLON)

Normal Motility and Function

The primary functions of the large intestine are to store food residues and to absorb water. Between what we drink and what is secreted into the stomach and intestine to help with food absorption, about 5 gallons of fluid is dumped into the large intestine every day. Most of this fluid has to be reabsorbed to prevent us from becoming quickly dehydrated. This process takes time, and as a result, about 95% of the contractions of the colon are unsynchronized (nonperistaltic). These contractions mix the contents of the large intestine back and forth but do not move them forward. As a consequence of this pattern of motility, food residues remain in the colon on average about 30 hours, and there are a lot of bacteria. The amount of bacteria varies depending on diet and use of antibiotics but can make up more than half of the weight of fecal material.

A second and very important type of motility that occurs in the large intestine is the high amplitude propagating contraction (HAPC). These contractions only occur 6–8 times per day in healthy people, but they are extremely strong contractions, which begin in the first part of the large intestine and sweep around all the way to the rectum; they stop just above the rectum. These contractions move the contents of the large intestine ahead of them, and they will often trigger a bowel movement, or at least the urge to have a bowel movement. Very slow contractions such as those seen in the upper part of the stomach (changes in muscle tone) also occur in the large intestine and may be important in its function, but they have not been studied enough to know for certain what they do.

Constipation

The symptoms of constipation are infrequent bowel movements [usually described as less than 3 per week], passage of hard stools, and sometimes difficulty in passing stools. The sensations associated with constipation can include a constant feeling of needing to go, which can be very annoying, or a sensation of bloating or fullness. In children, constipation often leads to fecal incontinence.

One of the two motility problems that can lead to constipation is a decrease in the number of high amplitude propagating contractions in the large intestine. The test used to detect this is a transit time (also called a Sitzmark) study, which is done very simply: the patient swallows some small rings that can be detected on an x-ray. In our clinic, the patient swallows 24 rings per day for 5 days and a single x-ray is taken on the sixth day. The time it takes for fecal material to move through and out of the large intestine can be estimated by counting the number of rings remaining on the sixth day.

Diarrhea

The symptoms of diarrhea are frequent, loose or watery stools, and a subjective sense of urgency. Patients with diarrhea also may worry about loss of control over bowel movements. An excessive number of high amplitude propagating contractions can be a cause of diarrhea; it reduces the amount of time food residues remain in the large intestine for water to be reabsorbed. Changes in the motility of the small intestine may also occur, but there is little information available on this.

It is usually not necessary to perform tests to document the motility disorder associated with diarrhea, but your doctor may want to collect a stool sample to evaluate other causes for diarrhea. A symptom diary in which you record the number of bowel movements and rate their consistency (watery, loose, formed, etc.) for 1–2 weeks can be very helpful to your doctor in deciding on the most appropriate treatment. [IFFGD has a Daily Diary available that is designed specifically for gastrointestinal disorders.]

RECTUM AND PELVIC FLOOR

Normal Motility and Function

The primary functions of the rectum and pelvic floor muscles are to prevent incontinence (loss of control) and to allow defecation to occur. The rectum is very elastic, which allows it to store food residues prior to a bowel movement, but it

must also be stiff enough to funnel food residues toward the anus during a bowel movement. The rectum is also surrounded by sensory nerves that detect the filling of the rectum with food residues. This sensation of rectal filling enables us to consciously or unconsciously squeeze the external anal sphincter to prevent incontinence until we can reach a toilet. These sensory nerves are also involved in reflexes that let the sphincter muscles relax during a bowel movement.

Fecal Incontinence

Fecal incontinence means involuntary passage of fecal material in someone over the age of 4 years. The most common causes are (1) weakness of the anal sphincter muscles that allow us to voluntarily hold back a bowel movement; (2) loss of sensation for rectal fullness so we can't tell when to squeeze the sphincter muscles; (3) constipation, in which the rectum fills up and overflows; and (4) stiff rectum, in which the fecal material is forced through the rectum so quickly that there is no time to prevent incontinence by squeezing the sphincter muscles. Diarrhea can also lead to fecal incontinence.

Weakness of the sphincter muscles can result either from injuries to the pelvic floor muscles themselves or injuries to the nerves of these muscles. Delivering a baby is one of the most common causes of injuries to the muscles or nerves of the pelvic floor, but birth defects such as spina bifida and diseases such as diabetes mellitus and myasthenia gravis can also affect these nerves. Ulcerative colitis or other diseases that are associated with an inflammation of the rectal lining can cause a stiff rectum. Constipation with overflow incontinence is very common as a cause of fecal incontinence in children.

The medical evaluation to determine the cause of fecal incontinence will usually include a rectal manometry study in which a tube with a balloon on its tip is put into the rectum. The tube has sensors on its sides to measure pressures in the area of the sphincter muscles. This test provides information on rectal sensation, stiffness of the rectal wall, and strength of the sphincter muscles. An electromyographic (EMG) test may also be performed to determine whether there is any damage to the nerves that go to the anal sphincters. A special type of ultrasound study is also frequently done to find out whether there are tears in the sphincter muscles.

Hirschsprung's Disease

There are actually two anal sphincter muscles: an internal anal sphincter that is part of the intestines, and an external anal sphincter that is part of the pelvic floor muscles. The internal anal sphincter normally stays closed to prevent the leakage of gas or liquid from the rectum, but when the rectum fills up with gas or fecal material, a reflex causes it to open to allow the bowel movement to pass through. The nerves that this reflex depends on are sometimes missing at birth, with the result that the internal anal sphincter stays tightly closed and bowel movements cannot occur. This congenital (birth) defect is called Hirschsprung's disease. It can be detected by rectal pressure measurements showing that the internal sphincter does not relax when the rectum is distended by a balloon. Alternatively, Hirschsprung's disease can be diagnosed by snipping off a part of the lining of the rectum to check for the presence of the nerve cells.

Outlet Obstruction Type Constipation (Pelvic Floor Dyssynergia)

The external anal sphincter, which is part of the pelvic floor, also normally stays tightly closed to prevent leakage. When you try to have a bowel movement, however, this sphincter has to open to allow the fecal material to come out. Some people have trouble relaxing the sphincter muscle when they are straining to have a bowel movement, or they may actually squeeze the sphincter more tightly shut when straining. This produces symptoms of constipation. The medical evaluation for this type of constipation will usually begin with the type of anal manometry and/or pelvic floor electromyographic tests that are described above. However, another useful test is to put a small balloon or some thick pasty material into the rectum and test whether the patient can pass it. The first test is called the balloon defecation test, and the second test is called defecography.

Summary

The gastrointestinal tract is divided into four distinct parts that are separated by sphincter muscles; these four regions have distinctly different functions to perform and different patterns of motility (contractions). They are the esophagus (carries food to the stomach), stomach (mixes food with digestive enzymes and grinds it down into a more-or-less liquid form), small intestine (absorbs nutrients), and colon (reabsorbs water and eliminates undigestible food residues). Abnormal motility or abnormal sensitivity in any part of the gastrointestinal tract can cause characteristic symptoms: food sticking, pain, or heartburn in the esophagus; nausea and vomiting in the stomach; pain and bloating in the small intestine; and pain, constipation, diarrhea, and incontinence in the colon and rectum. There are tests to determine whether the motility (contractions) in each part of the gastrointestinal tract are abnormal, and these tests provide guidance to the physician or surgeon in how best to treat these symptoms.

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This article is in no way intended to replace the knowledge or diagnosis of your doctor. We advise seeing a physician whenever a health problem arises requiring an expert's care.

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