



# Gastrointestinal Motility Disorders of the Esophagus and Stomach

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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. Some contractions move along pushing contents ahead of it. At other times, the muscles squeeze more or less independently of each other, 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. This article describes the normal patterns of esophageal and stomach motility and sensation, along with the symptoms that can result from abnormal motility or sensations.

Esophagus

**Normal motility and function.** The function of the esophagus is simply to transport food from the mouth to the stomach, and powerful, synchronized (peristaltic) contractions follow each swallow to accomplish this task. Between swallows, the esophagus usually does not contract. There is a sphincter muscle separating the esophagus from the stomach (called the lower esophageal sphincter, or LES), which normally stays tightly closed to prevent acid in the stomach from washing up into the esophagus. However, when we swallow, this sphincter muscle opens up (relaxes) so that the food we swallow can enter the stomach.

**Gastroesophageal reflux disease (GERD).** The most common symptom that occurs in the esophagus is heartburn, which is caused when acid washes up into the esophagus

repeatedly (gastroesophageal reflux) and irritates the lining of the esophagus. This happens when the lower esophageal sphincter (LES) separating the stomach from the esophagus does not work properly; the function of this sphincter is to prevent reflux from occurring when the stomach contracts. This can be due to: a weak sphincter muscle, too frequent spontaneous relaxations of the sphincter, or hiatal hernia. Hiatal hernia means that the stomach pushes up into the chest above the sheet of muscle that separates the abdomen from the chest (this muscle sheet is called the diaphragm). A hiatal hernia weakens the sphincter. Gastroesophageal reflux disease may be diagnosed by an *ambulatory pH* study, which is a recording of the frequency with which acid washes up into the esophagus. This is done by putting a small, soft tube with one or two sensors on it through the nose and into the esophagus. It is connected to a battery-operated computer for 18-24 hours to test for acid. Usual activities can be conducted during this test. [Other tests include endoscopy, in which the esophagus is examined using a thin fiber optic tube, and esophageal manometry, which measures pressure to determine if the esophagus and LES are functioning properly.]

**Dysphagia.** Dysphagia means ineffective swallowing. Sometimes this occurs when the muscles of the tongue and neck that push the food into the esophagus are not working properly because of a stroke or a disease affecting the nerves or muscles. However, food can also stick because the lower esophageal sphincter does not relax to let the food into the stomach (a disorder called *achalasia*), or because the esophagus contracts in an uncoordinated way (a disorder called *esophageal spasm*). Dysphagia can cause food to back up in the esophagus and lead to vomiting. There may also be a sensation of something getting stuck or a sensation of pain. Tests for dysphagia include *esophageal manometry*, which means that a small tube containing pressure sensors is placed down through the nose into the esophagus to measure the contractions of the esophagus and the relaxation of the lower esophageal sphincter. This test lasts about 30 minutes.

**Functional chest pain.** Sometimes patients have pain in their chest that is not like heartburn (no burning quality) and that may be confused with pain from the heart. Particularly if you are over 50 years of age, your doctor will always want to

find out if there is anything wrong with your heart, but in many cases the heart turns out to be healthy. In many patients with this kind of pain and no heart disease, the pain comes from spastic contractions of the esophagus, or increased sensitivity of the nerves in the esophagus, or a combination of muscle spasm and increased sensitivity. The test that is used to determine the cause is esophageal manometry – the same test described above to investigate symptoms of food sticking in the chest. Ambulatory pH studies may also be used to see if gastroesophageal reflux may be the cause of the chest pain.

**Normal motility and function.** One function of the stomach is to grind food into smaller particles and mix it with digestive juices so the food can be absorbed when it reaches the small intestine. The stomach normally empties its contents into the intestine at a controlled rate. The stomach has three types of contractions: (1) There are rhythmic, 3 per minute, synchronized contractions in the lower part of the stomach, which create waves of food particles and juice which splash against a closed sphincter muscle (the pyloric sphincter) to grind the food into small particles. (2) The upper part of the stomach shows slow relaxations lasting a minute or more that follow each swallow and that allow the food to enter the stomach; at other times the upper part of the stomach shows slow contractions which help to empty the stomach. (3) Between meals, after all the digestible food has left the stomach, there are occasional bursts of very strong, synchronized contractions that are accompanied by the opening of the pyloric sphincter muscle. These are sometimes called “housekeeper waves” because their function is to sweep any indigestible particles out of the stomach. Another name for them is the migrating motor complex.

**Delayed gastric emptying (gastroparesis).** The symptoms of delayed gastric emptying include nausea and vomiting. Poor emptying of the stomach can occur for several reasons: (1) The outlet of the stomach (the pylorus and duodenum) may be obstructed by an ulcer or tumor, or by something large and indigestible that was swallowed. (2) The pyloric sphincter at the exit of the stomach may not open enough or at the right times to allow food to pass through. This sphincter is controlled by neurological reflexes to insure that only very tiny particles leave the stomach and also to insure that not too much acid or sugar leaves the stomach at one time, which could irritate or injure the small intestine. These reflexes depend on nerves that sometimes become damaged. (3) The normally rhythmic, 3 per minute contractions of the lower part of the stomach can become disorganized so that the contents of the stomach are not pushed towards the pyloric sphincter. This also usually has a neurological basis; the most common cause is longstanding diabetes mellitus, but in many patients the cause of delayed gastric emptying is unknown, so the diagnosis given is *idiopathic* (meaning cause unknown) *gastroparesis*.

Tests used to evaluate patients with delayed gastric emptying usually include endoscopy to look inside the stomach, and gastric emptying (a nuclear medicine study) to measure how quickly food leaves the stomach. The test of gastric emptying involves eating food that has a radioactive substance added to it, so that the rate of emptying of the stomach can be measured with a type of Geiger counter (gamma camera). Another, less frequently used test is the electrogastrogram, which measures small electrical currents that come from the stomach muscle and that indicate whether the 3 per minute contractions of the lower stomach are occurring normally. The contractions of the stomach can also be measured directly by passing a tube with pressure sensors on it down the nose and into the stomach.

**Functional dyspepsia.** Many patients have pain or discomfort that is felt in the center of the abdomen above the belly button. Some examples of discomfort that are not painful include: fullness, early satiety (feeling full soon after starting to eat), bloating, or nausea. There is no single motility disorder that explains all these symptoms, but about a third of patients with these symptoms have delayed gastric emptying (usually not so severe that it causes frequent vomiting), and about a third show a failure of the relaxation of the upper stomach following a swallow (abnormal gastric accommodation reflex). About half of the patients with these symptoms also have a sensitive or irritable stomach, which causes sensations of discomfort when the stomach is filled with even small volumes. A gastric emptying study (see above) can show whether there is poor emptying of the stomach. The other motility disorders are more difficult to detect, but scientists have developed a computer-controlled pump called the *barostat* which can show: (1) whether the upper stomach relaxes adequately during eating, and (2) how much filling of the stomach it takes to cause pain or discomfort.

### 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). One of these regions is the esophagus, which carries food to the stomach where contents are mixed with digestive enzymes and ground into a more-or-less liquid form. Abnormal motility or abnormal sensitivity in any part of the gastrointestinal tract can cause characteristic symptoms, such as food sticking, pain, heartburn, nausea, and vomiting. There are tests to determine whether the motility 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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