The Vagus Nerve and Hunger

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KNH304 Advanced Nutrition

October, 22 2012

Many times, we tend to only think of our nerves as controlling the voluntary movements of our body like skeletal muscles, eyelids, or throat. However, there are many nerves in our body that control involuntary functions within our bodies that we are not even aware of like hormone release into the blood from endocrine glands, the beating of the heart, and the function of many other internal organs such as the stomach. One very important nerve to the body is the vagus nerve, which is a cranial nerve that provides parasympathetic information to the central nervous system about the state of the body's organs. Specifically in the abdomen, the vagus nerve sends signals to the brain to innervate the digestive tract, which stimulates gastrointestinal secretions and controls the involuntary movements of the gut. The vagus nerve plays an extremely important role in digestion as well as the regulation of hunger and can be manipulated in order to impact hunger, appetite, and weight and loss.

The enteric nervous system is the main controller of the digestive system and all of its functions. It is an elaborate system that contains a network of neurons that are located within the walls of the gut. The enteric nervous system can be both parasympathetic and sympathetic as dictated by the central nervous system (Hill, 2012). The main source of parasympathetic activity within the digestive tract comes from the vagus nerve, which is a major component of enteric nervous system having branches and neurons in the liver, portal vein, billiary system, pancreas, mouth, esophagus, stomach, gallbladder, and small intestine. Although, the vagus nerve is also found in the throat, lower airways, heart, aorta, and thymus—as seen in Figure 1 (Berthoud, 2000). Although the vagus nerve stimulates some inhibitory parasympathetic processes, the fact that its parasympathetic stimulation generally increases gastrointestinal activity tells us that the vagus nerve functions to increase activity for digestion (Medeiros, 2012). The vagus nerve controls peristalsis, segmentation, and other patterns of contraction of the smooth muscle of the

gut(Hill, 2012). It is important to note that 90 percent of the nerve fibers in the vagus nerve carry information from the digestive system to the brain, rather than the digestive system to the gut. This bit of information suggests that the enteric nervous system play other roles in regulation the functions of digestion other than its mechanical movement (Hill, 2012). The vagus nerve contains mechao-receptors, chemo-receptors, temperature-sensors, and osmo-sensors, which can all send information to the brain about the food that has been consumed and is being digested by the gut (Berthoud, 2000). Once these messages from the vagus nerve stemming from the gut are processed in the brain, the brain sends signals to innervate the different parts of the digestive system to secrete certain enzymes or to cause movements in the gut. Simply put, the vagus nerve lets the body know what is going on within the entire digestive system—whether you consciously realize it or not—so your body can react accordingly.

Hunger and appetite are regulated through many hormones such as insulin, leptin, adiponectin, and ghrelin, just to name a few. These hormones travel through the blood to communicate with the hypothalamus, which controls a person's food intake and weight. The most important of these hormones to hunger is ghrelin, which signals to the brain to let it know that the stomach is empty. This prompts hunger pangs and a drop in energy metabolism (Mahan, 2012). The previous mechanism does not involve the vagus nerve. The following is another mechanism for letting the brain know that the body is hungry that does not involve hormones, but involves the vagus nerve. When the stomach is full, stretch receptors within the stomach communicate with the brain via the vagus nerve to indicate satiety. When the stomach is empty, the inactive stretch receptors causes the vagus nerve to innervate the brain to indicate hunger (Mahan, 2012).

There are some surgical procedures that affect the vagus nerve, leading to weight loss and decreased hunger and appetite. Gastric bypass surgery can decrease the number of stretch receptors that send signals to the brain that the stomach is empty, which could lessen hunger and food intake, although feelings of an empty stomach still exist. Because the vagus nerve is stimulated by parietal cells in the proximal stomach to secrete acid, another alternative to gastric bypass surgery is vagotomy. Vagotomy involves the severing of the vagus nerve. Depending on the extent of vagotomy, hydrochloric acid secretions can be reduced and gastric emptying can be slowed, both of which decrease the rate of digestion and increase the length of satiety (Mahan, 2012). These effects can lead to weight loss or control in an individual.

Because the vagus nerve is part of the nervous system and its function is to relay messages to and from the brain, it appears that there is no way to alter its activity via the diet—there is little research on this hypothesis. When food enters the mouth and makes its way through the digestive system, the vagus nerve will be responsible for telling the brain what it tastes like and how it makes the person feel, but there may be no mechanism to alter how the nerve relays the messages via the diet. Potential research on this subject includes experimentation with food stuffs or drugs that may inhibit stretch receptors in the stomach or the nerve endings and impulses of the vagus nerve. Inhibition of stretch receptors or signaling in the vagus nerves could lead to decreased hunger, appetite, and increased weight loss.

Without the vagus nerve, there would be no way for the digestive system to communicate and coordinate with the brain and carry out digestion. The vagus nerve send signals to the brain about what is and is not happening within the digestive system, which signals the brain to stimulate gastrointestinal secretions and involuntary movements of the gut. It is easy to see that the vagus nerve plays an extremely important role in digestion as well as the regulation of hunger

and appetite. Although there seems to be no way to manipulate the effects of the vagus nerve via the diet due to lack of research, there are surgical manipulation that can be done to the nerve, which have been shown to decrease hunger, appetite, and induce weight loss.

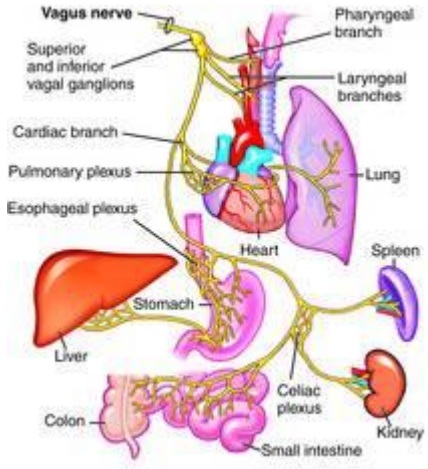

Figure 1. The vagus nerve (Mosby, 2009).

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