Anatomy and Physiology of the Human Gastrointestinal Tract: Exploring the Functions and Interactions of the Digestive System

Leonid Rusin*

Department of Anatomy, University of Edinburgh, Old College, South Bridge, Edinburgh EH8 9YL, UK

Abstract

The human gastrointestinal tract is a long, muscular tube that extends from the mouth to the anus, and is responsible for the digestion and absorption of nutrients from food. The human gastrointestinal (GI) tract, also known as the digestive system, is a complex series of organs that work together to break down food and absorb nutrients. It consists of several organs, including the mouth, esophagus, stomach, small intestine, large intestine, rectum, and anus.

Keywords: Human gastrointestinal tract • Enteric nervous system • Secretions

Introduction

The mouth is responsible for the initial mechanical and chemical digestion of food, with the help of the teeth, tongue, and salivary glands. The food is then pushed down the esophagus and into the stomach, where it is further broken down by stomach acid and enzymes. The small intestine is the site of most nutrient absorption, with specialized structures called villi and microvilli increasing the surface area for absorption. The large intestine absorbs water and electrolytes from the remaining material, forming feces which are then eliminated through the rectum and anus.

The digestive process is controlled by several hormones and neural mechanisms, including the enteric nervous system which regulates local gut function, and the central nervous system which coordinates overall digestive function [1]. The function of the GI tract is to digest food and absorb nutrients, while also eliminating waste products from the body. The process of digestion begins in the mouth, where food is broken down into smaller pieces through chewing and mixing with saliva. The food then travels down the esophagus and into the stomach, where it is further broken down by gastric acid and enzymes.

After leaving the stomach, the partially digested food enters the small intestine, where it is further broken down and nutrients are absorbed into the bloodstream. The small intestine is made up of three sections: the duodenum, the jejunum, and the ileum. The large intestine, or colon, is responsible for absorbing water and electrolytes from the remaining food matter, as well as storing and eliminating waste products in the form of feces [2]. The rectum and anus are the final parts of the GI tract, where feces are stored and eliminated from the body.

Description

The GI tract is controlled by the enteric nervous system (ENS), which

is sometimes referred to as the "second brain" because it can function independently of the central nervous system. The ENS is made up of a network of neurons that regulate digestive functions such as peristalsis (the movement of food through the GI tract), secretion of digestive enzymes and hormones, and blood flow to the GI tract. The GI tract is also regulated by hormonal signals from other organs such as the pancreas, liver, and gallbladder. For example, the pancreas secretes digestive enzymes and hormones such as insulin and glucagon, which play a role in regulating blood sugar levels.

The enteric nervous system, also known as the "second brain," is a complex network of neurons that is embedded in the walls of the gastrointestinal tract. It controls various functions of the GI tract, including the mixing and propulsion of food, secretion of digestive enzymes and hormones, and absorption of nutrients and water [3]. The enteric nervous system can also work independently of the central nervous system, although the two systems are connected through a bidirectional communication pathway known as the gut-brain axis.

The digestive process involves the secretion of several hormones such as gastrin, secretin, and cholecystokinin, which stimulate the production and release of digestive enzymes and juices. Neural mechanisms, including the enteric nervous system and the autonomic nervous system, also play a crucial role in regulating digestion [4]. The enteric nervous system, which is often referred to as the "second brain," is a complex network of neurons that controls the motility and secretions of the gastrointestinal tract. The autonomic nervous system, on the other hand, regulates the activity of the digestive organs through sympathetic and parasympathetic pathways.

The gastrointestinal tract (GI tract) is responsible for digesting and absorbing nutrients from the food we eat. Motility and secretions are essential functions of the GI tract that help facilitate this process. Motility refers to the movement of food through the GI tract, which is accomplished through the coordinated contraction and relaxation of smooth muscles in the walls of the GI tract. This process is controlled by the enteric nervous system, which is sometimes referred to as the "second brain" because it can function independently of the central nervous system [5]. The enteric nervous system controls the muscles that move food through the GI tract in a process called peristalsis.

Secretions are substances released by the cells in the lining of the GI tract that help digest food. These secretions include enzymes, acids, and mucus. Enzymes are proteins that speed up chemical reactions, and they are responsible for breaking down food molecules into smaller, more easily absorbed units. Acids help break down proteins and kill bacteria that might be present in the food we eat. Mucus is a slippery substance that coats the lining of the GI tract, protecting it from the corrosive effects of the acids and enzymes.

Conclusion

Overall, motility and secretions are critical functions of the GI tract that work together to digest and absorb nutrients from the food we eat. The specific types and amounts of secretions vary throughout the GI tract. For example, the stomach secretes hydrochloric acid and enzymes that help break down proteins, while the pancreas secretes enzymes that break down carbohydrates, fats, and proteins. The liver produces bile, which helps break down fats, and the small intestine secretes enzymes that break down carbohydrates, fats, and proteins.

References

1. Ding, Jian-Hong, Zhe Jin, Xiao-Xu Yang and Jun Lou, et al. "Role of gut microbiota *via* the gut-liver-brain axis in digestive diseases." *World J Gastroenterol* 26 (2020): 6141.

2. Li, Cheng, Wenwen Yu, Peng Wu and Xiao Dong Chen. "Current *in vitro* digestion systems for understanding food digestion in human upper gastrointestinal tract." *Trends Food Sci Technol* 96 (2020): 114-126.

3. Wang, Qinying, Fanying Guo, Yutao Jin and Yanlei Ma. "Applications of human organoids in the personalized treatment for digestive diseases." *Signal Transduct Target Ther* 7 (2022): 336.

4. Stillhart, Cordula, Katarina Vučićević, Patrick Augustijns and Abdul W. Basit, et al. "Impact of gastrointestinal physiology on drug absorption in special populations—An UNGAP review." *Eur J Pharm Sci* 147 (2020): 105280.

5. Sensoy, Ilkay. "A review on the food digestion in the digestive tract and the used *in vitro* models." *Curr Nutr Food Sci* 4 (2021): 308-319.