THE EFFECT OF PANCREATIC JUICE ON THE MOTOR AND EVACUATORY FUNCTIONS OF THE STOMACH

Gulnoza Abdujabbarova
Tashkent International University of Chemistry
Faculty of General Medicine
1st-year student

Annotation. This article discusses the anatomical structure of the stomach, the glandular cells in its mucous membrane and the substances from which they are produced, the pancreas and its location, the sphincter of Oddi and its location, the effect of pancreatic juice on the motor and evacuation functions of the stomach.

Key words: anatomical structure of the stomach, the pancreas and its location, the sphincter of Oddi, pancreatic juice, motor and evacuation functions of the stomach.

Аннотация. В этой статье рассматриваются анатомическое строение желудка, железистые клетки в его слизистой оболочке и вещества, из которых они вырабатываются, поджелудочная железа и ее расположение, сфинктер Одди и его расположение, влияние панкреатического сока на моторную и эвакуаторную функции желудка.

Ключевые слова. Строение желудка, слизистая оболочка желудка, слизистых клеток, желудочные железы, поджелудочная железа, сфинктер ОДДИ, маторные и эвакуаторные функции желудка.

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Introduction

The stomach is an essential organ of the digestive system. It is a muscular organ resembling a curved hook, although its shape may vary. The stomach is located in the abdominal cavity at the level of the 11th thoracic vertebra. It is directly connected superiorly to the esophagus and inferiorly to the duodenum. Its volume ranges from 1 to 3 liters, depending on the degree of filling and the tension of its walls.

Anatomical Structure of the Stomach

The stomach consists of four parts: the cardia (inlet), body, fundus, and pyloric (outlet) part. The cardia connects the stomach with the esophagus, while the pyloric region connects it with the duodenum.

At the cardiac region, there is a sphincter that allows the passage of liquids and semi-digested food and prevents the reflux of gastric contents into the esophagus. In the pyloric region, the pyloric sphincter regulates the passage of digested food into the duodenum and prevents its backflow.

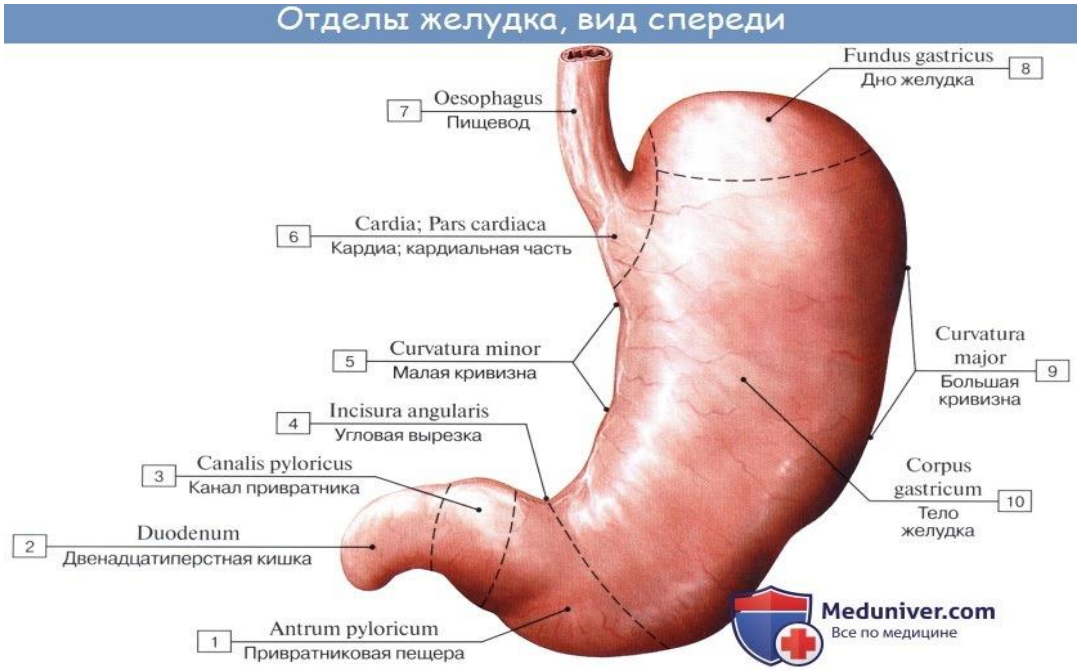

Figure 1. Structure of the stomach

Structure of the Gastric Wall

The stomach wall is composed of four layers: mucosa, submucosa, muscular layer, and serosa.

- The **mucosa** contains glandular cells responsible for the secretion of gastric juice.
- The **submucosa** contains blood vessels and nerve fibers and connects the mucosa with the muscular layer.
- The **muscular layer** consists of inner circular, middle oblique, and outer longitudinal muscle fibers.
- The **serosa** forms the outer protective layer.

The glandular cells of the gastric mucosa are divided into three types:

- **Chief cells** – produce pepsinogen
- **Parietal cells** – secrete hydrochloric acid
- **Mucous cells** – produce mucus

Together, these secretions form gastric juice.

Composition and Function of Gastric Juice

Gastric juice is a colorless, transparent, acidic liquid. It contains hydrochloric acid, mineral salts, and enzymes (primarily pepsin). The concentration of hydrochloric acid in human gastric juice is approximately 0.4–0.5%.

Hydrochloric acid plays a crucial role in digestion by:

- softening and breaking down food,
- activating digestive enzymes,
- destroying microorganisms,
- stimulating pancreatic secretion,
- promoting the formation of digestive hormones.

Mucus secreted by accessory cells neutralizes excess acidity, protects the mucosa, and facilitates digestion.

Food may remain in the stomach for 3 to 8–10 hours, during which it is gradually processed and passed into the duodenum.

The stomach possesses both motor and evacuatory functions. The contraction of smooth muscle fibers in the gastric wall ensures the motor function, that is, the movement function of the stomach. Its primary role is to mix the ingested food and facilitate its passage from the stomach into the intestine. The pyloric sphincter plays a crucial role in regulating the transfer of food into the intestine.

Due to contractions of the gastric muscles, food passes from the stomach into the intestine. The rate at which food leaves the stomach depends on its composition. As a result of the interaction between the mucous membrane of the gastric outlet and hydrochloric acid present in gastric juice, the pyloric sphincter opens. At this moment, a portion of the gastric contents enters the duodenum, causing the normally alkaline environment there to become temporarily acidic.

The acid then acts on the mucous membrane of the duodenum, triggering a reflex contraction of the pyloric muscles, which leads to closure of the sphincter. Consequently, the passage of food from the stomach into the duodenum is temporarily halted. Under the influence of secretions such as pancreatic juice, intestinal juice, and bile, the acid is neutralized, and the intestinal environment returns to an alkaline state, after which the process resumes.

Since digestion in the intestine takes a relatively long time, the restoration of an alkaline environment ensures that a new portion of food enters the intestine only after the previous portion has been sufficiently processed. The closure of the pyloric opening in response to hydrochloric acid entering the duodenum is known as the **pyloric reflex**.

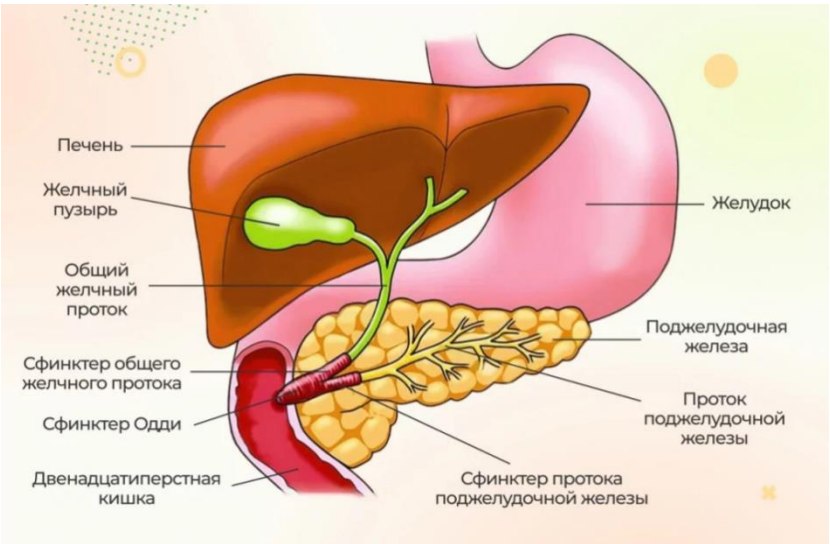

Figure 3. Structure of the pancreas

Experimental Studies

Physiologists G.F. Korotko, A.N. Aripov, and G. Askhanov (1990) conducted scientific research in the field of digestive physiology. They investigated the motor and evacuatory functions of the stomach under conditions where the pancreatic duct was surgically relocated. In these experiments, the effect of pancreatic juice on gastric motor and evacuatory functions was studied.

The experiments were mainly carried out on dogs. Initially, a Basov fistula was surgically created in the stomach. Then, gastric motor activity under fasting conditions was recorded using a balloonographic method. In the empty stomach of the dog, cycles of contractions appeared approximately every 1.5 hours. Each contraction period lasted 15–20 minutes and was followed by a resting phase.

Subsequently, gastric evacuatory function was studied under the same conditions. For this purpose, 0.2% hydrochloric acid (HCl) and 0.2% sodium bicarbonate solutions were used. In each experiment, 200 ml of the solutions were introduced into the stomach through the fistula. The rate of evacuation was measured every 10 minutes.

Under normal conditions, it was found that hydrochloric acid was evacuated significantly more slowly than the alkaline solution. This is because acid strongly stimulates the mucous membrane of the duodenum, triggering the pyloric reflex, which keeps the pyloric sphincter closed until the pH in the duodenum returns to neutral.

In the next stage, a 0.2% sodium bicarbonate solution was introduced, and its evacuation rate was also measured at 10-minute intervals. The evacuation of sodium bicarbonate occurred more rapidly, as the duodenal environment remained alkaline.

The same experiment was repeated after surgically relocating the pancreatic duct 30 cm into the jejunum. This constituted the second stage of the study. In this case, pancreatic juice did not enter the duodenum.

As a result:

- Gastric motility increased by approximately 1.5 times compared to normal conditions.
- Changes in evacuatory function were also observed.
- The evacuation of sodium bicarbonate slowed down.
- The evacuation of hydrochloric acid accelerated.

These findings indicate that when pancreatic juice, which performs a neutralizing function, does not enter the duodenum, it negatively affects both the motor and evacuatory functions of the stomach.

Conclusion

Pancreatic juice, intestinal juice, and bile entering the duodenum play a crucial role in regulating the motor and evacuatory functions of the stomach.

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