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MINI REVIEW

A New Look at the Gross Anatomy of the Stomach to Understand How it Functions

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Abstract

The anatomy of any organ in the human body indicates its function. Understanding the structure of the stomach can help in understanding how it functions. In this short review, we have tried to clarify the gross anatomy of the stomach in relation to its proper function. The stomach is a hollow organ, located in the upper left quadrant of the abdomen. Its domed upper part, called the fundus, lies cranial to the cardiac orifice, or in other words, above the entrance to the stomach from the esophagus. This gas-filled area helps the stomach perform its function of breaking down and churning the food that enters the body of the stomach. Furthermore, the diaphragm separates the fundus of the stomach from the heart and left lung. The largest part of the stomach, called the body, is the section that lies directly below the upper "cardiac" orifice of the stomach, and receives swallowed food. The body of the stomach leads to a horizontal section called the pylorus, which terminates at the sphincter muscle in the distal "pyloric" orifice. The strong pyloric sphincter muscle keeps food inside the stomach, where it is emulsified and digested, then it opens to direct the food into the duodenum. To perform the mechanical breakdown of food properly, the fundus must be empty of food and the body of the stomach must contain fluids that help emulsify the food. Any attempt to completely fill the stomach with food while eating may hinder the digestive process. Filling of the stomach may also compress the chest cavity, including the lungs and heart, which may lead to dyspnea and palpitation. Therefore, it is recommended to avoid completely filling the stomach with food while eating, as this is crucial for proper digestion and, consequently, good health.

Key Words: *Digestion; Gastroscopy; Gastric emptying; Pylorus; Dietary intake; Mucous membrane*

Introduction

The anatomy of any structure in the human body reveals its function, and vice versa. Understanding the structure of any organ helps to understand how it works [1]. One of these organs is the stomach, which receives food from the oral cavity via the pharynx and esophagus after it has been swallowed. The stomach is the widest part and most expandable part of the digestive tract, located between the esophagus and the duodenum. Superior to the stomach is the diaphragm, which separates it from the left lung and heart [2-3].

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The primary function of stomach is to break down, digest, and store food until it is digested [4]. The human stomach plays a vital role in the digestive process. This function is accomplished through a complex and not fully understood mechanism [5]. In this brief overview, we attempt to clarify the gross anatomy of the stomach and its relationship to proper function. This will enhance understanding of the mechanisms of these functions and positively impact healthcare.

The stomach is the widest and most expandable part of the digestive tract. A helpful way to remember the stomach's anatomy is relating it to the number 2. It has two ends, each with an orifice (the upper cardiac orifice and the lower pyloric orifice), two borders or curvatures (lesser and greater curvatures), and two surfaces (anterosuperior and posteroinferior). The cardiac orifice connects the stomach to the esophagus at its beginning, while the pyloric orifice connects the stomach to the duodenum at its end. This pyloric orifice is guarded by the pyloric sphincter muscle to prevent food from flowing back into the stomach after it has left the stomach and before it reaches the duodenum [4]. The pylorus can be surgically identified by feeling the thickening of the sphincter muscle, observing a constriction on its outer surface, and the presence of a prepyloric vein (vein of Mayo) crossing in front of it. This vein connects the gastric and gastroepiploic veins [6]. On the other hand, the upper sphincter of the stomach above its cardiac end, called the lower esophageal sphincter, relies mainly on the contraction of the diaphragmatic muscle that surrounds the lower end of the esophagus. With the diaphragm contracting during inspiration and thus increasing intra-abdominal pressure which may put pressure on a full stomach, the lower end of the esophagus is closed by contraction of the surrounding diaphragmatic muscle, thus preventing gastroesophageal reflux.

The anterosuperior surface of the stomach is covered by the peritoneum of the greater sac. This surface is in close proximity to the left lobe of the liver. The diaphragm separates it from the left pleura, the lung, the pericardium and the heart, and the anterior abdominal wall. The posteroinferior surface rests on a set of structures that form what is called the stomach bed. The stomach bed includes the following structures from top to bottom: the left gastric vessels, the left crus of the diaphragm (located behind the fundus of the stomach), the spleen, the splenic vessels (the artery above the body of the pancreas and the vein behind it), the body of the pancreas, the transverse colon and the left colic flexure with the left colic vessels, the transverse mesocolon containing the middle colic vessels, the left kidney, and the left adrenal gland. A full stomach can put pressure on the lung and heart, causing shortness of breath or dyspnea and heart palpitations [4] (Figure 1).

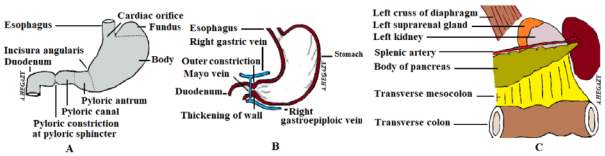

Figure 1) *Diagrams showing the anatomy of stomach: A) Parts of stomach; B) Features at pylorus; C) Stomach bed structures.*

The empty stomach is J-shaped and can be divided into a small, dome-shaped upper part called the fundus and a lower larger part called the body. The largest part of the stomach, called the body, is the section located directly after the upper "cardiac" orifice of the stomach, and it receives swallowed food. The body of the stomach leads to a horizontal section called the pylorus, which consists of three parts. These parts include the pyloric antrum, the pyloric canal, and the pyloric sphincter muscle (Figure 1). The pyloric antrum lies horizontally above the duodenum and leads to a narrow "pyloric" canal that terminates at the pyloric sphincter muscle in the distal "pyloric" orifice [7].

The rugae of gastric mucous membrane facilitates the rapid passage of swallowed liquids to the lower part of the stomach. Along the lesser curvature near its lower end, there is a notch called angular notch (or incisura angularis). This incisura represents the beginning of the pyloric canal, which is the horizontally widened section. In endoscopic examination, the transition from the body of the stomach to the antrum is identified by the transition from the rugae to the flat mucosa [8].

The stomach's location extends to include three areas in the upper abdomen: the left hypochondrium (beneath the costal margin), epigastrium, and the umbilical region. It lies directly below the diaphragm, and in front of the spleen and pancreas. The stomach performs several functions, including storing food (with a capacity of about 1500 ml in adults), mixing food with gastric secretions to form semi-liquid chyme, and controlling the rate at which chyme is delivered to the duodenum so that digestion and absorption can occur efficiently [4]. Furthermore, it plays an important role in the movement of the digestive system through its function as a pump, which is anatomically formed from the distal two-thirds of the body, and the pylorus [5]. The stomach also breaks down food that reaches it from the mouth without chewing, through mechanical and chemical decomposition. Mechanical digestion occurs through the movement and mixing of food. This is due in large part to the oblique muscular layer of the stomach wall, which provides a powerful force for digestion. Chemical digestion, on the other hand, occurs through the production of gastric juices. For example, the enzyme pepsin begins digesting proteins in the stomach by breaking them down into polypeptides and oligopeptides [9]. The mechanical breakdown of food can be described as the completion of chewing within the stomach and its transformation into smaller particles. This process relies not only on the contraction of the oblique muscular layer of the stomach but also on the churning and mixing of food within it through its powerful shaking between the opposing folds of the peritoneum. Anatomically, the stomach is the only part of the digestive system suspended between two folds of peritoneum: the lesser omentum connecting its lesser curvature to the liver and the greater omentum hanging from its greater curvature. The greater omentum descends in front of coils of intestine forming a fatty apron, then folds upon itself to reach the transverse colon and the transverse mesocolon. Surgeons often refer to the greater omentum as the abdominal policeman. This is because its free portion can surround the site of infection and prevent its spread into the peritoneal cavity, thus preventing serious diffuse peritonitis. The greater curvature is also attached to two ligaments above the greater omentum. These are the gastrophrenic ligament, which connects the greater curvature of the stomach to the diaphragm, and the gastrosplenic ligament, which connects it to the hilum of the spleen [4,10]. Embryologically, peritoneal folds associated with the greater curvature, including gastrophrenic ligament, gastrosplenic ligament, greater omentum and lienorenal ligament, arise from the dorsal mesogastrium; while those associated with the lesser curvature, including lesser omentum and falciform ligament, arise from the ventral mesogastrium (Figure 2) [11]. This means that the only part of the digestive tract that retains both peritoneal folds on both sides is the stomach. These ligaments can help hold the stomach in place, especially when it is full of food.

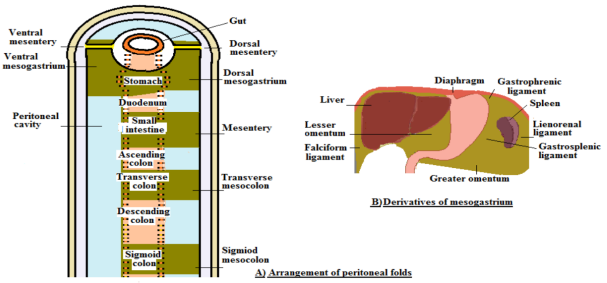

Figure 2) *Development of peritoneum and peritoneal folds [11].*

To perform the mechanical breakdown of food properly, the fundus must be empty of food and the body of the stomach must contain fluids that help emulsify the food. This can be explained anatomically by the fact that the fundus of the stomach is located at a higher level than the cardiac orifice of the stomach, where it connects with the distal end of the esophagus. Therefore, the contents of the fundus are usually gases that appear below the diaphragm in chest X-ray images as a gastric bubble in that region (Figure 3) [12-13]. The empty fundus allows stomach to vigorously shake its contents of food inside to allow it to decompose, especially for food that reaches it without being properly chewed in the oral cavity. Proper breakdown of food within the stomach requires not only an empty part of fundus of the stomach, but also an adequate amount of fluid to easily emulsify the ingested food. Any attempt to completely fill the stomach with food while eating may hinder the digestive process, which begins by breaking down food inside the stomach into smaller particles. Not only that, but it may also compress the chest cavity, including the lungs and heart, which may lead to respiratory distress and impaired heart contraction. The fundus receptively relaxes to expand and accommodate ingested food and air. This is crucial for the stomach's ability to receive food. Churning within the stomach's body and antrum (lower funnel-shaped portion of the stomach), where muscular contractions grind food and mix it with digestive juices allow for food contents to decompose [9]. This is, especially important for food that reaches it without being properly chewed in the oral cavity. Proper breakdown of food also requires an adequate amount of fluid to easily emulsify the ingested food.

Figure 3) *A chest x-ray image shows gas in the fundus of stomach below the heart and left lung, which is separated from them by the diaphragm [13]. (1: Left clavicle; 2: Aortic arch; 3: Pulmonary trunk; 4: Left auricle; 5: Left ventricle; 6: Apex of the heart; 7: Gases in the fundus of the stomach; 8: Left cupola of diaphragm; 9: Right costodiaphragmatic recess; 10: Right cupola of diaphragm; 11: Inferior vena cava; 12: Right atrium; 13: Superior vena cava; 14: Air in the trachea).*

Since the stomach develops from the foregut, it receives its blood supply from branches of the coeliac trunk [11]. These branches include the right and left gastric arteries that anastomose along the lesser curvature, the left and right gastroepiploic arteries that anastomose along the greater curvature, and the short gastric arteries to the fundus of the stomach (Figure 4). On the other hand, veins correspond to arteries, except they reach the liver via the portal vein [4]. This ensures the filtration and detoxification of the gastric venous drainage, which carries food digestion products to be metabolized in the liver, before the blood reaches the systemic circulation via the hepatic veins, and then the inferior vena cava [14].

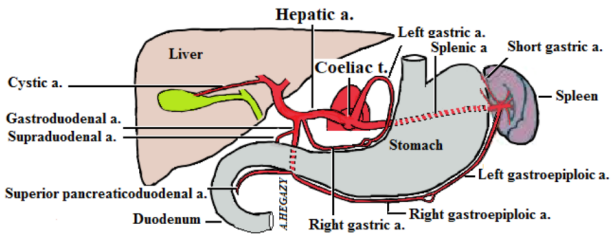

Figure 4) *Diagram showing the arterial blood supply of stomach from the branches of coeliac trunk. (t.: trunk; a. artery).*

Conclusion

The anatomy of stomach is designed to perform its function optimally. It is advisable to avoid overeating during meals, as this not only distorts its structure but may also negatively affect its function.

Acknowledgement

The figures in the paper are all original creations of the author.

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