

EDITORIAL

Rereading the Anatomy of the Duodenum as a Distinct Part of the Digestive Tract

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Abstract

The duodenum is known to be a part of the small intestine that, along with the oral cavity, esophagus, stomach, jejunum, ileum, cecum, ascending colon, transverse colon, descending colon, sigmoid colon, rectum, and anal canal, forms the digestive “or alimentary” tract. The small intestine is commonly described as consisting of three parts: the duodenum, jejunum and ileum. In this article, we will explain the anatomy of the duodenum, focusing on its characteristics that distinguish it from the rest of the small intestine. The duodenum has a

distinct anatomy that differs from the other small intestine sections in several aspects, including the reception of bile and pancreatic secretions and its location as a retroperitoneal structure. The jejunum and ileum form the coils of the small intestine that are exposed when the peritoneal cavity is opened during surgery. Therefore, it is important to distinguish the duodenum from the rest of the small intestine and consider it as an independent part of the digestive tract and not part of the small intestine, especially in medical education. This would make understanding its anatomy easier and eliminate confusion, especially for undergraduate medical students.

Key Words: *Duodenum; Small intestine; Gastrointestinal tract; Digestive tract; Anatomy; Pylorus*

Introduction

The digestive tract, also called the alimentary or Gastro Intestinal Tract (GIT), includes the oral cavity, esophagus, stomach, small intestine, large intestine (or colon), rectum, anal canal, and ends at the anus [1]. The small intestine is the longest part of the digestive system. It extends from the pylorus of stomach to the ileocecal junction. It is divided into three parts: duodenum, jejunum, and ileum [2]. However, the duodenum has a

distinct anatomy that distinguishes it from the other sections known collectively as the coils of small intestine or the jejunum and ileum. The duodenum lies retroperitoneally having lost its dorsal mesentery during early development while the coils of the small intestine retain their dorsal fold of peritoneum known as the mesentery allowing them to move freely within the abdominal cavity [3].

The term “duodenum” is a Latin word referring

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to the number 12, as the length of the duodenum was indicated as being approximately equal to 12 fingers [4]. The duodenum has been mentioned that it represents the first fixed part of the small intestine, and is located deep in the epigastric and umbilical abdominal regions. Duodenum is the fixed, widest and shortest part of small intestine measuring at about 10 inches (25 cm) long. It is C-shaped, surrounding the head of the pancreas, forming an incomplete circle around it. It receives the opening of the bile duct and the main pancreatic duct (Figures 1 and 2). At this site, there is a small elevation in the inner wall of the duodenum, called major duodenal papilla [2]. The opening of this papilla and the part preceding it, the ampulla of Vater (hepatopancreatic duct), are surrounded by a smooth muscular sphincter called the sphincter of Oddi, which regulates the flow of digestive juices from the liver and pancreas into the duodenum. Furthermore, the sphincter muscle prevents the reflux of duodenal contents into the bile duct and pancreatic duct, and promotes gallbladder filling between meals [5,6].

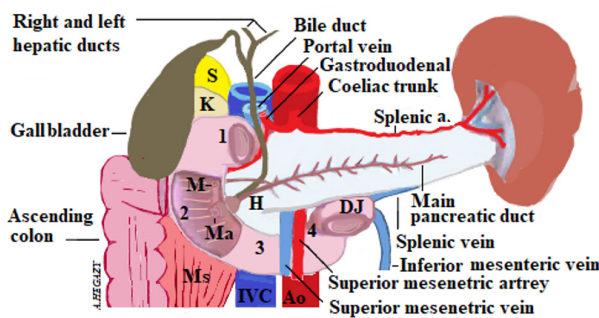


Figure 1) A diagram showing parts of the duodenum and relations.

S: Right suprarenal gland; K: Right kidney; 1: First part of duodenum; 2: Second part of duodenum (opened); 3: Third part of duodenum; 4: Fourth part of duodenum; DJ: Duodenojejunal flexure; M: Minor duodenal papilla; Ma: Major duodenal papilla (papilla of Vater); H: Head of pancreas; Ms: Psoas major muscle; IVC: Inferior vena cava; Ao: Abdominal aorta.

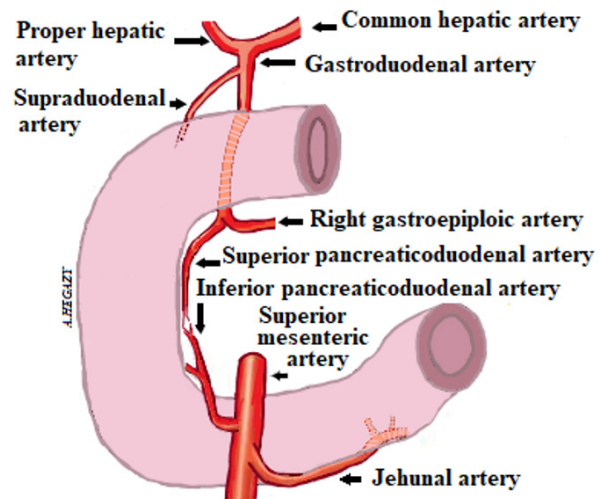


Figure 2) A diagram showing arterial supply of the duodenum.

The duodenum is nourished by two major blood vessel systems. This shift is embryological in origin, as the duodenum is the junction between the foregut and midgut. The gut arises early in embryonic development, beginning at the end of the third week and completed during the fourth week. It originates in the inner portion of the secondary yolk sac located within the embryo's body after folding of the embryonic disc (Figures 1 and 3). The part of the gut in the cranial part of the embryonic fold forms the foregut, the middle part opposite the vitellointestinal (or called vitelline) duct forms the midgut, and the part in the caudal part forms the hindgut [3,7].

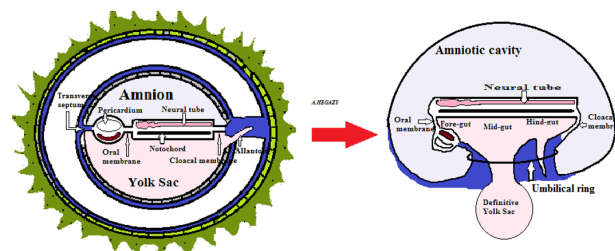


Figure 3) Longitudinal section in developing trilaminar germ disc showing cranio-caudal folding of embryo [3].

The proximal half of the duodenum, derived from the foregut, is supplied by the following celiac trunk branches: the right gastric artery, which is a branch of the proper hepatic

artery, and the supraduodenal, superior pancreaticoduodenal and right gastroduodenal (right gastroepiploic artery) arteries, which are usually branches of the gastroduodenal artery. The distal half of the duodenum, which arises from the midgut, is supplied by the following superior mesenteric artery branches: the inferior pancreaticoduodenal artery, which arises directly from the superior mesenteric artery, and the duodenal branches, which arise from the first jejunal artery (from the superior mesenteric artery). On the other hand, the corresponding veins drain into the portal circulation through the superior pancreaticoduodenal vein, which drains directly into the portal vein, and the inferior pancreaticoduodenal vein, which drains into the portal vein by joining the superior mesenteric vein [4]. Therefore, the duodenum has a distinct anatomy when compared to the other parts, and is often excluded clinically from the term small intestine. The other parts, jejunum and ileum, are collectively known as the coils of small intestine.

Duodenal cap is the first one inch of the duodenum. It resembles the stomach in having attachment to the lesser omentum and greater omentum. It is relatively dilated and smooth-walled. It is the most common site of duodenal ulcer. This is because it is the first site of the acidic gastric secretion meeting with duodenal mucosa before mixing with the alkaline duodenal secretion [8].

The first part of the duodenum is two inches long. It begins at the pylorus, and extends horizontally at the level of the first lumbar vertebra (transpyloric level), beginning half an inch to the right of the median plane. The second part is three inches long and extends vertically from the level of the first lumbar vertebra to

the third lumbar vertebra. The third part is four inches long. It extends horizontally at the level of the third lumbar vertebra (subcostal plane). The fourth segment is one inch long. It ascends from the level of the third lumbar vertebra to the second lumbar vertebra and terminates at the duodenojejunal flexure, approximately one inch to the left of the median level. Here, a well-defined suspensory ligament called the ligament of Treitz forms an important anatomical landmark between the duodenum and the jejunum [9]. The ligament extends from the upper surface of the duodenojejunal junction and ascends to meet the right crus of the diaphragm holding this junction in place [10].

The coils of small intestine (jejunum and ileum) represent the free part of the small intestine, measuring about six meters in length. The jejunum represents the upper (or proximal) two fifths, while ileum represents the lower (or distal) three fifths of coils of small intestine. They are connected to the posterior wall of the abdomen by a fold of peritoneum, called mesentery (Mesentery, mes: middle & enter: intestine). There is no definitive distinction between the jejunum and ileum. Resection of a third or even half of the small intestine does not impact normal digestive functionality [2]. Attachment of small intestine coils to the mesentery, as well as significant movement of a portion of the intestine along a fixed point, can lead to its twisting, which is called volvulus [11]. Unlike the other two parts of the small intestine, the duodenum has two distinct ends: one located after the pylorus, and the other at the duodenojejunal flexure, which connects to the right crus of the diaphragm via the ligament of Treitz. The duodenal end can also be distinguished by the inferior mesenteric vein (Figure 1).

Based on the significant anatomical difference, the duodenum can be excluded as part of the small intestine and considered anatomically an independent part of the digestive system. This may avoid confusion in dealing with medical education, especially for undergraduate medical students.

Conclusion

The duodenum has a distinct anatomy from the rest of the small intestine. It is fixed structure on the posterior abdominal wall having no mesentery. It has a double arterial supply from both the celiac trunk and superior mesenteric

arteries, which is explained by the double origin from the caudal part of the foregut and the cranial part of the midgut. Therefore, it can be considered an independent part of the digestive tract, connecting the stomach to the small intestine, and not part of the small intestine. Revisiting the anatomy of the duodenum as a distinct part of the digestive system makes it easier to understand in medical education, especially for undergraduate medical students.

Acknowledgment

All diagrams are original and drawn by the author.

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