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Gross Morphological and Arterial Blood Supply Study of the Stomach in Adult Domestic Cats (Felis Catus)

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Abstract: This study describes the gross morphology and arterial blood supply of the stomach in domestic cats (Felis catus). Seven healthy adult cats were fasted and euthanized. General anesthesia was induced by the intramuscular injection of xylazine (1 mg/kg) and ketamine (10 mg/kg). The abdomen was opened through a midline incision, and the stomach was inspected in situ for gross morphology and morphometric analysis. For the arterial system supply of stomach study, the common carotid artery was injected with colored latex, Dissection was done to trace the arteries supplying the stomach, morphological results the stomach was a simple, C-shaped organ in the left cranial part of the abdomen, with greater and lesser curvatures and cardiac and pyloric orifices. The stomach was divided into the cardiac, fundic, and pyloric parts. The stomach wall was elastic, and there were no differences in stomach between male and female. The internal surface had prominent, branching longitudinal folds, which were more numerous in the fundic and body parts and fewer in the pyloric part. Arterial supply came from branches of the celiac artery, including the left gastric, hepatic, and splenic arteries. The gastric and gastroepiploic arteries formed arterial arcades and anastomoses along the curvatures.

Keywords: Felis catus, General anesthesia, Intramuscular injection, C-shaped organ.

RESEARCH PAPER

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INTRODUCTION

The stomach is a particular expansion of the alimentary canal, which lies caudal to the diaphragm and thus represents the functional and anatomical link between the esophagus and the small intestine (Bowen, 2005). In carnivorous mammals, it is typically located in the left cranial quadrant of the abdominal cavity and is a simple, monogastric organ (Hildebrand & Goslow, 2001). This arrangement is consistently reported in traditional veterinary anatomical texts and is characterized by the presence of a well-defined greater and lesser curvature and a prominent incisura angularis along the lesser curvature. This particular arrangement is always attributed to the adaptations imposed by the high-protein diet and the intermittent feeding habit of obligate carnivores.(Nisa' *et al*., 2010)

In the domestic cat (Felis catus), the stomach is described as a sac-like, J- to C-shaped muscular organ that is primarily located to the left of the median plane. It is topographically located caudal to the diaphragm, partially hidden by the liver, and is in close anatomical relation with the spleen and the proximal duodenum (LANGER, 2002). The cardiac part is located near the ninth intercostal space, where the esophagus enters dorsally. The fundus and body constitute the major part of the organ and are primarily limited to the left cranial part of the abdominal cavity, while the pyloric part extends medially and slightly to the right before continuing as the duodenum. The pylorus is a muscular outflow regulator that controls gastric emptying.(Miller *et al*., 2013)

Morphologically, the feline stomach is completely glandular in character and possesses longitudinal mucosal folds (rugae) that allow considerable distention during the feeding process. The rugae are most pronounced in the fundic and body parts of the stomach and become less prominent towards the pyloric canal (Mahmood, 2023). Compared with the dog, the cat's stomach is said to possess a relatively narrower lumen and less prominent rugae, although the same overall morphological pattern is maintained in both species. The stomach is surrounded by the visceral peritoneum and is attached along its lesser and greater curvatures to the lesser and greater omenta, respectively, forming part of the omental bursa.(Mahmood, 2023)

Comparative anatomical studies conducted among carnivorous groups of animals have shown that, despite interspecific variations in size and distensibility, the basic gastric design is remarkably conserved. In domestic dogs and wolves, the stomach is C- to J-shaped and placed transversely in the left cranial quadrant of the abdomen, with a moderately expandable fundus to temporarily store ingesta(Perrin & Curtis, 1980). In the large felines such as the lion *(Panthera leo)* and tiger *(Panthera tigris),* the stomach is highly distensible with a broad fundic part and well-developed greater curvature, which supports rapid ingestion of large quantities of prey (Gelberg, 2014). In bone-eating carnivores such as the spotted hyena *(Crocuta crocuta)*, the stomach is characterized by thickened muscular walls and other specialized features related to the prolonged retention and digestion of dense tissues (Dyce *et al*., 2010). Smaller carnivores such as the ferret (Mustela putorius furo) maintain the simple J-shaped stomach but show reduced storage capacity consistent with rapid gastrointestinal transit (Mans, 2021). These observations confirm that, despite a uniform morphological pattern characterized by division into cardiac, fundic, and pyloric parts with specific curvatures, the relative size and distensibility of the carnivore stomach vary in accordance with ecological and dietary specialization.

The vascular supply to the stomach in carnivores originates from the celiac trunk, which is an unpaired ventral branch of the abdominal aorta. In the cat, the celiac trunk normally gives rise to three main branches: the left gastric, common hepatic, and splenic arteries (Fossum & Duprey, 2019). The left gastric artery mainly serves the cardia and the lesser curvature and anastomoses with the right gastric artery, a branch of the common hepatic artery, to form a continuous arterial chain along the lesser curvature. The splenic artery gives rise to the short gastric arteries, which supply the fundus, and the left gastroepiploic artery, which runs along the greater curvature (Angelou *et al*., 2023). The right gastroepiploic artery, which is a branch of the gastroduodenal artery, completes the arterial chain along the greater curvature by extensive anastomosis with its left counterpart. This pattern provides a rich collateral circulation that ensures continuous blood flow to the stomach wall.(Marais, 1988)

The aim of study is to established clinical importance of accurate gastric anatomy in surgical procedures, endoscopic studies, and the analysis of diagnostic imaging, the need for accurate and systematic anatomical description remains valid. Accordingly, the purpose of this study is to provide a comprehensive gross morphological description of the stomach in adult domestic cats (Felis catus) and to document its arterial blood supply.

MATERIALS AND METHODS

Seven clinically normal adult domestic cats (Felis catus) of both sexes were used in this study to examine the gross morphology and arterial blood supply to the stomach. All the animals were subjected to routine clinical examination before selection to confirm the absence of systemic or gastrointestinal disease. The animals were kept in standard laboratory conditions (Cooney & Kipperman, 2023) to provide standardized gastric conditions and to reduce variability in stomach distension, the animals were starved for 24 hours before the procedure but allowed access to water. General anesthesia was induced by the intramuscular injection of xylazine (1 mg/kg) and ketamine (10 mg/kg). Sufficient depth of anesthesia was confirmed before proceeding. For vascular injection, a ventral cervical incision was made to expose the jugular groove. Blunt dissection was carried out to carefully separate the surrounding tissues and locate the common carotid artery. The artery was isolated and cannulated. Controlled exsanguination (bleeding) was carried out through the exposed artery to remove the circulating blood and reduce intravascular clot formation, thereby making it easier to distribute the injection medium evenly. After exsanguination, the arterial system was flushed with warm physiological saline to remove any remaining blood and prevent dilution artifacts. A solution of warm latex and ammonia with carmine dye was prepared to increase vascular contrast. The injection medium was slowly and carefully injected under pressure through the cannulated common carotid artery to fill the arterial system completely, including the smaller gastric arteries, without causing vascular rupture or extravasation. Once adequate perfusion was obtained, the carotid artery was then ligated and closed tightly to avoid leakage of the injected substance. The specimens were then left alone at room temperature for about 24 hours to permit complete polymerization and hardening of the latex in the vascular system, a midline abdominal incision was made to open the abdominal cavity. The stomach was then inspected in situ to note its topographic relationships with surrounding viscera, such as the liver, spleen, diaphragm, and proximal duodenum. Gross morphological details were noted, including shape, position, curvatures, and regional variations into cardiac, fundic, and pyloric parts. Morphometric data were obtained using a digital caliper for measurements and a highly sensitive electronic balance for weighing. Variables measured included body weight, stomach weight, and dimensions of the greater and lesser curvatures, all measurements were taken with great care to avoid tissue distortion.

For vascular studies, meticulous dissection was done to follow the origin, course, branching, and anastomoses of the gastric arteries. Particular attention was paid to branches arising from the celiac trunk, including the left gastric, common hepatic, splenic, right and left gastroepiploic, and short gastric arteries. High-quality photographs were taken to record the distribution of the arteries and their relation to particular parts of the stomach. This approach enabled clear visualization of both gross morphological details of the stomach and its arterial patterns, ensuring accurate anatomical recording with minimal procedural artifacts.

Results of Morphology

In all the specimens studied, the stomach of the adult domestic cat (Felis catus) was found to be a single-chambered, unilocular, C-shaped, dilated organ that was mainly located in the left cranial quadrant of the abdomen, the organ was located caudal to the diaphragm and mainly hidden ventrally and cranially by the visceral surface of the liver (figure 1). There was no gross anatomical variation in shape and location among the specimens .In topographic location, the stomach extended from the esophageal opening at the cardia to the pyloroduodenal junction. The esophagus opened dorsally, forming a clear gastroesophageal junction. The pyloric part was directed medially and slightly to the right, continuing as the proximal duodenum (figure 1). Laterally, the greater curvature was in close relation with the spleen, mainly along its fundic part. Morphometric measurements showed that the mean body weight was 4.09 ± 0.09 kg (table 1), while the mean stomach weight was 26.78 ± 0.18 g (table 1). The lesser curvature was 6.00 ± 0.05 cm long, while the greater curvature was 11.00 ± 0.07 cm long (table 2). The greater curvature was longer, more convex and more rounded, forming the ventrolateral margin of the organ, while the lesser curvature was shorter, concave, and directed dorsomedially. A clear incisura angularis was present along the lesser curvature at the junction of the body and the pyloric part (figure 1).

Externally, the stomach was surrounded by visceral peritoneum. The greater curvature was the site of attachment of the greater omentum, while the lesser curvature was the site of attachment of the lesser omentum. The serosal surface was smooth and glistening in all specimens, showing no signs of pathological changes.Anatomically, the stomach was readily distinguishable into three parts: the cardiac, fundic (body) and pyloric part. The cardiac part surrounded the esophageal opening and was relatively small in size (figure 2). The fundic part constituted the major part of the stomach and was characterized by a dome-shaped expansion along the greater curvature. The pyloric part was narrower and tubular, extending towards the duodenum and ending at the pyloric sphincter (figure2).

On opening the stomach along the greater curvature, the internal mucosal lining was uniformly glandular and brown in coloration. The longitudinal rugae were prominent, extending from the fundus to the body. The rugae were well-developed and irregularly branched in the fundic part (figure 3). In the cardiac part, the rugae were straighter and less branched. Towards the pyloric part, the rugae were less in height and number, becoming more crowded. The pyloric canal had a relatively smooth internal lining (figure 3).

The prominence of the rugae varied depending upon the degree of gastric distension, but the pattern of distribution was uniform in all specimens.

Arterial Blood Supply

The arterial blood supply to the stomach was from the celiac trunk, which was a solitary ventral branch of the abdominal aorta. The celiac trunk showed trifurcation into three main branches: the left gastric artery, the common hepatic artery, and the splenic artery (figure 5). The main pattern of branching was that of the classical carnivore pattern without any observable anomaly in the point of origin. The left gastric artery was a direct branch of the celiac trunk and ran cranially towards the lesser curvature. It supplied the cardiac part and the immediately superior part of the gastric body by means of numerous penetrating branches given off along the lesser curvature. It also anastomosed distally with the right gastric artery, thus forming a continuous arterial chain along the lesser curvature. The right gastric artery was a branch of the common hepatic artery and ran along the lesser curvature in a leftward direction to form the lesser curvature arcade.

The splenic artery had a leftward course towards the spleen and gave off several short gastric arteries towards the fundic part. These arteries pierced the dorsal wall of the gastric cavity near the greater curvature and supplied the fundic and surrounding body part. Moreover, the splenic artery gave off the left gastroepiploic artery, which descended along the layers of the greater omentum and proceeded along the greater curvature from the left to the right. The right gastroepiploic artery (figure 4). Originated from the gastroduodenal artery, which was a terminal branch of the common hepatic artery it proceeded from right to left along the greater curvature, where it established a distinct anastomotic arcade with the left gastroepiploic artery (figure 4). Several secondary arteries branched off from this arcade to supply the ventral gastric wall and surrounding serosal surfaces.

The pyloric part was supplied with supplementary arterial branches from the right gastric artery and from the gastroduodenal artery branches (figure 6). These arteries supplied the pyloric canal and helped establish vascular continuity with the proximal duodenum.

Table 1: Showing the weight of body cat and weight of the stomach

Parameter	Mean ± SE
Body Weight (kg)	4.09 ± 0.09
Stomach Weight (g)	26.78 ± 0.18

Table 2: Showing length the lesser and greater Curvature of stomach

Parameter	Mean ± SE
Lesser Curvature	6.00 ± 0.05
Greater Curvature	11.00 ± 0.07

Figure 1: Stomach (S) esophagus (E) liver (f) duodenum (D) greeter curvature (Y) lesser curvature (U)

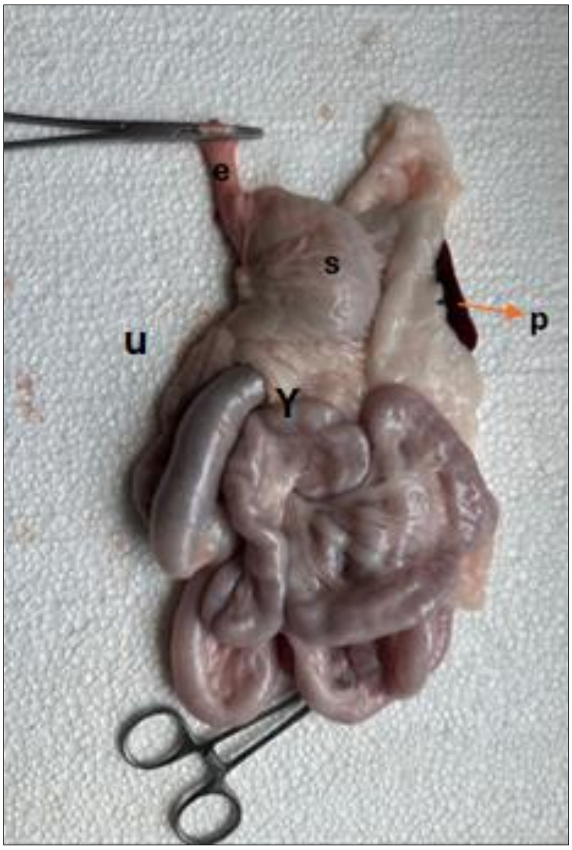

Figure 2: Stomach (S) esophagus (E) spleen (P) cardic fundic pyloric

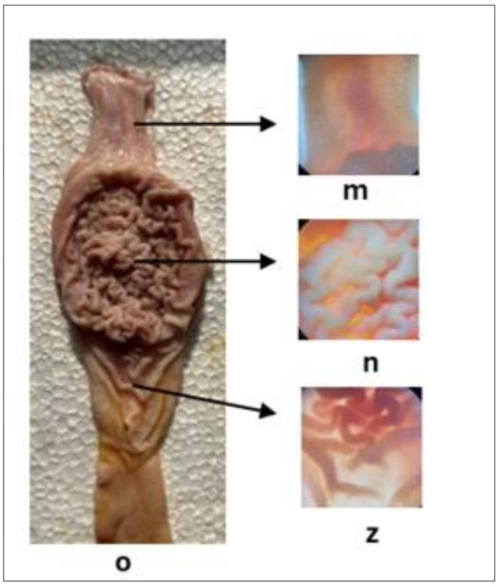

Figure 3: (m) cardiac (n) fundic (w) pyloric (o) internal stomach

Figure 4: Left gastroepiploic artery (x) right gastroepiploic artery (v)

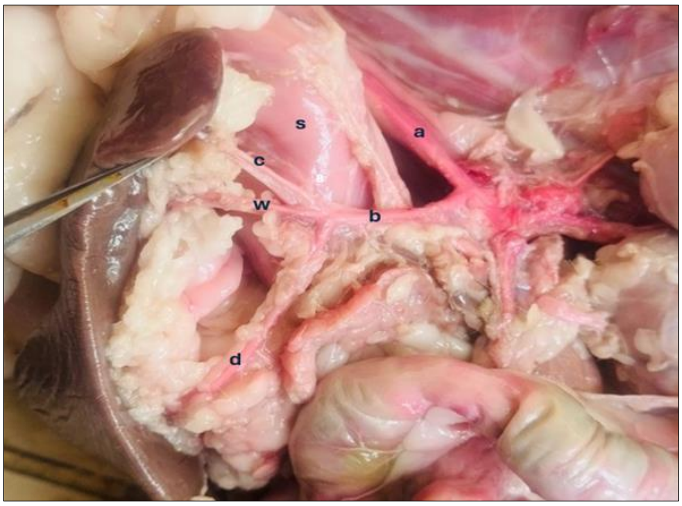

Figure 5: (s) stomach, (a) abdominal aorta, (b) Celiac trunk, (c) hepatic artery, (c) left gastric artery (w), splenic artery (d)

Figure 6: (s) stomach, (a) abdominal aorta, (b) Celiac trunk, (a) right gastric artery (r), gastroduodenal artery (g)

Discussion

The current results show that the stomach of the adult domestic cat (Felis catus) follows the classical monogastric carnivore type as described in standard veterinary anatomical texts (Frandson *et al*., 2009).The C-shaped form, primary location in the left cranial quadrant, and distinct separation into cardiac, fundic, and pyloric parts match descriptions in felines. This arrangement with (Konig & Bragulla, 2007) which is a reflection of the gastric blueprint shared among obligate carnivores.

The topographic relations between the stomach and other abdominal structures, such as the diaphragm, liver, spleen, and proximal duodenum, match feline abdominal anatomy as documented. The ventrocaudal extension of the greater curvature and its relation to the greater omentum, as well as the dorsomedial position and lesser omentum attachment of the latter, match previously documented mesenteric patterns in carnivores. The presence of a well-defined incisura angularis along the lesser curvature is in agreement with (Payne, 2012)classical descriptions of gastric segmentation in monogastric animals.

Morphometric data obtained for stomach weight and curvature length are within the anatomical range for domestic cats as reported in comparative anatomical texts. The body weight to stomach weight ratio is in agreement with the carnivore gastric capacity adapted to intermittent feeding (Soybel, 2005). The greater curvature being longer than the lesser curvature is a standard anatomical pattern documented in carnivorous mammals and was confirmed in the current study.

Internally, the stomach mucosa is entirely glandular, and the presence of well-developed longitudinal rugae matches standard descriptions of the feline stomach. The prominent development of rugae in the fundic and body parts, in relation to the relatively reduced development towards the pyloric canal, is in agreement with functional views described in anatomical literature. The distribution pattern is indicative of distensibility in the fundic part and controlled gastric emptying in the pyloric part. The comparatively less prominent development of rugae in cats, as compared to dogs, as described in the (Choong, 2012), indicates interspecific variation while preserving the same basic pattern.

The arterial pattern described in this study is in agreement with the classical foregut pattern of vascularization described for carnivores. The trifurcation of the celiac trunk into the left gastric, common hepatic, and splenic arteries is the characteristic feline pattern. The formation of arterial arcades along both the lesser curvature (via left and right gastric arteries) and the greater curvature (via left and right gastroepiploic arteries) is in agreement with (Angelou *et al*., 2023). The supply of the fundic part by short gastric arteries from the splenic artery further supports previously described vascular distribution patterns.

The development of prominent anastomoses along both curvatures ensures constant supply of the gastric wall and collateral circulation, a characteristic widely accepted in mammalian gastric vascularization. The lack of accessory trunks or abnormal branching patterns in the examined specimens is in agreement with the (Marais, 1988)constant vascular pattern described for domestic cats in anatomical literature.

Compared to other carnivores, such as canids and large felines, which share the same basic gastric pattern despite differences in relative size and distensibility(Stevens & Hume, 2004),In contrast to bone-scavenging specialists like hyenas, where enhanced muscle power and maximal distensibility are highlighted in the literature, the domestic cat exhibits an intermediate gastric capacity typical of its diet. Such comparisons provide evidence for the view that the domestic cat stomach retains the basic carnivore pattern without excessive morphological specialization.

Conclusion

1. The stomach of adult domestic cats (Felis catus) is a simple, monogastric, C-shaped organ that lies mostly in the left cranial quadrant of the abdomen and is distinctly divided into cardiac, fundic, and pyloric parts.
2. The stomach has well-marked greater and lesser curvatures, a prominent fundic part, and a distinct pyloric part that extends into the duodenum.
3. Morphometric data offer basic anatomical measurements that are part of the scanty quantitative information available for this species.
4. The arterial blood supply is from the celiac artery via its main branches, especially the left gastric, splenic, and hepatic arteries.
5. These arteries run along both curvatures and form arterial anastomoses to provide a rich supply of blood to all parts of the stomach, characteristic of carnivores.

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