A review of Morphological and Histological Features of stomach in carnivores

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Abstract

The purpose of this study is to get a basic understanding of the primary anatomical and histological characteristics seen in carnivores. Moreover includes information on typical medical assessment and is deemed valuable for surgical treatment as well as anatomy instruction. The present study its highlight in anatomical and histological characteristics for stomach in different species of carnivores such as dogs, jackal, grey wolf, grey mongoose, domestic and wild cat. The anatomical structures which appear similarity approximately in carnivores, but different in some of histological features, especially in lamina muscularis and stratum compactum layer. The anatomical structure of stomach in carnivores consist of simple monogastric, have three region; (cardiac, fundic and pyloric) region. Histologically, most of researches mention the stratum compactum was not established or never investigate in carnivores or not highlight for this layer. The stratum compactum composed of thick layer collagen fibers extend beneath mucosa which appeared clearly in fundic region, this layer rested on the lamina muscularis. Such results indicate that the stomach in carnivores contain special of collagen layer called (stratum compactum).

Keywords: Histological and Anatomical , stomach, carnivores**,** review

مراجعة للصفات المورفولوجية والنسيجية للمعدة في الحيوانات آكلة اللحوم

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مستخلص

الغرض من هذه الدراسة هو الحصول على فهم أساسي للخصائص التشريحية والنسيجية الأولية التي تظهر في الحيوانات آكلة اللحوم. علاوة على ذلك يتضمن تقديم معلومات للمجالات الطبية، ويعتبر ذا قيمة للتدخل الجراحي بالإضافة إلى تعليمات التشريح. الدراسة الحالية سلطت الضوء على الخصائص التشريحية والنسيجية للمعدة في أنواع مختلفة من الحيوانات آكلة اللحوم مثل الكلاب ، ابن آوى ، الذئب الرمادي ، النمس الرمادي ، القط الداجن والبرية. تظهر الخصائص التشريحية متشابهة تقريبًا في الحيوانات آكلة اللحوم ، ولكنها تختلف في بعض السمات النسيجية ، خاصة في الصفيحة العضلية والطبقة المدمجة يتكون الهيكل التشريحي للمعدة في الحيوانات آكلة اللحوم من أحادي المعدة ، ولها ثلاث مناطق ؛ منطقة (الفؤاية ، قاع المعدة والبوابية). من الناحية النسيجية ، تشير معظم الأبحاث إلى أن الطبقة المدمجة لم يتم تأسيسها أو لم يتم التحقق منها مطلقًا في الحيوانات آكلة اللحوم أو لم يتم تسليط الضوء عليها لهذه الطبقة. تمتد الطبقة المدمجة المكونة من ألياف الكولاجين ذات الطبقة السميكة تحت الغشاء المخاطي والتي ظهرت بوضوح في منطقة قاع المعدة ، وتستقر هذه الطبقة على الصفيحة العضلية. تشير هذه النتائج إلى أن المعدة في الحيوانات آكلة اللحوم البرية تحتوي على طبقة خاصة من الكولاجين تسمى (الطبقة المدمجة

Introduction

The stomach is one of main organs in body used to digest and store food [1]. In mammals, the stomach's primary job is to crush down big particles ones so that they may be ingested more quickly into the intestine [2]. There are many differences in different species 'in the digestive systems. The requirements differ significantly between carnivores, herbivores, and omnivores, monocular species are quite different from polygastric species [3].

Carnivores usually chew and tear its food, owing to their brachidont teeth, whereas herbivores munch side - to - side and have hypsodont teeth [4,5]. Unlike humans, they do not contain hydrolytic enzymes in their saliva. Carnivores' digestive tracts are slimmer than herbivores'. This is attributable to the fact that their flesh is rich in many nutrients, and they are capable of extracting them more easily. The stomach of a carnivore is substantially bigger than that of a herbivore. Their stomachs occupy around 60 to 70 percent of their gastrointestinal system. They contain powerful digesting enzymes in their gut. They release approximately ten times more hydrochloric acid in their stomach than humans or herbivores. In compared to other mammals, their caecum is substantially smaller.

The stomach of carnivores is morphologically similar to those of humans, both in structure and in that it does have a glandular epithelial surface that covers the full mucosal surface, which unlike stomachs of horses and pigs, which have an aglandular cutaneus mucosa that covers roughly 1/3 of the surface. Additionally, farm animals have quite a glandular abomasum, which corresponds to the ventriculus, and a glandular forestomach containing three main components, namely rumen, reticulum, and omasum [6, 7].

In dogs, the stomach is a tiny, muscular tube that sits directly below the diaphragm. It serves to store food during feeding, combine food with stomach acid and other fluids, and raise digestive enzymes into the duodenum of the small intestine. The anatomical limitations are the lower esophageal sphincter (valve), which allows nutrients to pass through the opening of the cardiac region, lesser and greater curvatures, these structures give the outline of stomach and the pyloric sphincter allow for nutrition pass to the small intestine. Fundus, body and antrum are the main functional areas [8, 9].

At the xiphoid level, the canine stomach can always be reached instantly caudal to the liver. The feline gastric fundus as well as body is left-sided structures in a more midline destination with the pylorus. In both species, the left-sided dorsal fundus should be followed ventrally and to the right, toward the pylorus [10].

Various animals' stomachs have been previously documented. With its caudo-ventrally and left-facing convex surface, the stomach of an empty or partially filled dog appears to be in the form of a "C." The cat's stomach was structured similarly to (C), and it had a smaller diameter than the dog's [11]. The cardia (a segment combining with the esophagus), the fundus (a wide blind backpack on the dorsal and left side of the cardia), the body (principal segment extending from the fundus to the pylorus), and the pylorus (roughly the entire distal third) are the three regions of the dog's stomach [12,13].

In cats, the stomach appears as a pouch structure with flexible walls that can hold a lot of food. The pylorus is a muscular valve at the bottom of the stomach that transfers nutrients absorbed from the small intestine [14]. In grey mongoose, the stomach was found caudal to the diaphragm in the hypochondrial sub-region, which connects the esophagus and small intestine.

The stomach has been about (4) cm long and has two ends, two faces—parietal and visceral—two curvatures—lesser and larger—and two openings—cardiac and pyloric. The stomach have included crosswise restricted region that was divided into two sacs. The smaller curved of the stomach was extremely short, attaching to the intestinal tract via the omentum, but the larger curving was quite broad, extending dorsally to link the internal surface of the liver. Internally, there was no distinct delineation seen between three areas of the stomach: cardiac, fundic, and pyloric. The esophagus was linked to the cardiac portion of the stomach around at the cardiac entrance. The fundus, or body, of the stomach, and the pyloric area, which was attached to the duodenum. The pyloric area was divided into two sections; the pyloric antrum was a depression that connected to the stomach's body. The presence of 14 lamellae on the interior surface of such stomach was notable; those folds were taller and larger in the fundic area and subsequently decreased in length forward towards the pyloric zone [15]. The present study noticed the stomach of grey mongoose had longitudinal mucosal folds inside of stomach (internally), these cord extended along the stomach regions, they were higher in fundic region, these structures give strength for stomach, because carnivores, mainly wild animals, require compressed organs for fermentation, they aid in the grinding and digesting of food.Also, these cords gave stomach more capacity and extension. This finding was reported also in tayra stomach [16].

Histologically

The mucosa, submucosa, muscularis externa, and serosa are the four layers that make up the stomach lining. There are three components of the stomach: cardiac, fundic, and pyloric [17,18,19], these layers made up the simple stomach animals. The mucosa of the stomach glands is detached into clear and black area. In dogs, the gastric pits had thick layer of mucous membrane in the clear zone [20].

Cardiac area: The gastric glands are located in the cardiac submucosa and the posterior section of the stomach lamina propria. In cutter stomach's cardiac zone the gastric pits of the grass are broad and walled with simple columnar epithelium. In the canine, the lamina propria had simple or branching gastric tubular glands that extended to the mucosa [20]. The cardiac glands are comparatively short coild- simple branched, releasing a mucous secretion. The nuclei are located in the basal region of the cells, which are cube shaped. These glands open into somewhat shallow cardiac pits. Parietal cells are situated at the intersection of the cardiac and fundic gland areas [21]. The cardiac region at the foveolar end of the neck, the parietal cells of the dog are comparatively more numerous, and they become comparably less numerous towards the lower gland. The chief cells form a layer of pyramidal cells that encircle the lumen with nuclei near the membrane in the basement [22].

In grey mongoose, we noticed the glands in cardiac zone were short -coiled glands occupied lamina propria. The secreting cells were columnar mucus type surrounded by myoepithelial cells. The gastric glands extended to varying distances, some extended from the base of gastric pits for long distance reaching to the muscularis mucosa, others glands were shorter just

located in the upper part of mucosa near to surface, the diameter of cardiac glands was 50 µm [23].

In grey mongoose, these glands consisted of five cell types: The stem cells were aggregation of dark-triangular shape, located in upper part of mucosa. The neck region of gastric glands lined with mucous neck cells that appeared lightly cuboidal to short columnar, these cells had basal rounded nuclei. In addition there were numerous of parietal cells distribution, among the secretory cells, these cells were large oval or rounded shape, located along upper part of glands filled with acidophilic granules in cytoplasm. The nucleus was rounded and centrally placed, the diameter of parietal cells was 12 µm. the ratio of these cells cardiac region was 22.5 cell\mm^2 ([23].

Fundic region: mucus-secreting surface neck cells, parietal (oxyntic) cells, chief (zymogen) cells, and enteroendocrine cells were found in this mucosa of stomachs [24].

In the foundic area of the canine stomach, bright basophilic chief cells with centrally circular nuclei and eosinophilic granular parietal cells remain prevalent. The existence of glands, which are a combination of pyloric gland cells and parietal cells with some of those distributed chief cells, distinguishes the transition zone between the fundic and pylorus areas. The thin line at the antral-fundic juncture contains fundic and antrum parts [25]. The fundus in carnivores is limited to muscularis mucosa and has a long body, small neck, and a slightly inflated blind end [26]. Basophils are abundant and distributed across the mucous membrane of canines, and feline, with no link to parietal cells [27].

Exocrine epithelial cells known as mucin cells (mucocytes cervicales), main cells (exocrinocytes principales), and parietal cells (exocrinocytes parietals) were discovered in the stomach secretions of Grey Wolf. Neck mucocytes had invaginations and transparent cytoplasm, whereas primary cells labeled as basophilic by pepsinogen and parietal cells labeled as eosinophilic by chloride ions. Within glandular tubules, solitary smooth muscle cells were discovered [29].

In grey mongoose, observed the gastric glands in this region were simple tubular branch, these glands include, the mucous neck cells which appeared as cuboidal to columnar shaped lightly stained with basal nucleus located in upper part of gastric glands. The parietal cells which to the gastric glands, found in a large numbers in neck of fundic region were distinguished from other cells. These cells were organized as straight cords, with a cell ratio of 31.6 cell\ mm. The zymogenic cells have been primarily seen in the bottom portion of the gastric glands. In furthermore, a large number of enterocytes cells were observed in the stomach glands between the chief cells. Because the glands were so closely packed, the quantity of connective tissue between them was decreased. The mucosa of the fundic area was sitting on a 2-3 fine coating of muscularis mucosa, with a thickness of around 80 µm, with the mucosa resting in a thick stripe layer of collagen fibers (stratum compactum) of 30 µm[23].

Pyloric region: In canines, equine, and swine, the pyloric glands possess greater gastric pits that occupy about halfway, half third, so one quarter of the stomach mucosa, accordingly. In

indigenous swine and muong, pylroric glands accounted for 32.1 and 37.8% of overall stomach area, correspondingly [29].

Pyloric glands invaded the deeper half of mucous membrane thickness in canines. The appearance of quarter moon shaped nuclei identifies the pyloric gland cells in the pyloric region. Pits are lined by mucous cells that formed the surface half of the pyloric mucous membrane [25].

In hamster's pyloric the membrane folds are highly developed, the change from fundus to pylorus was complete, with abrupt variations in tubular gland size and the lack of parietal cells in the pylorus. These glands were small-coiled tubularbranching, and gastric pits are deep. Mast cells are abundant in the lamina propria mucosae's basal area [30].

The current study observed the gastric mucosa in grey mongoose had simple coiled gastric glands, most of these gland were mucous acini with flattened nuclei located in base of cells, the diameter of pyloric gland approximately **(30-50)** µm. These glands consist of the four types of cells; mucous neck, chief, G- cells and enteroendocrine cells. The mucous neck cells were located in upper part of gland that appeared light color, short columnar shaped had oval nuclei basal poisoned. The G-cells were lightly cytoplasm, fried-egg in shape, located in upper part beneath mucous neck cells, had dark nucleus located centrally. Also, the present enteroendocrine cell was triangular in shape located in lower part of mucosa located above a thick layer of collagen fibers (stratum compactum).

In some places, the tunica muscularis consists of three muscular layers, these layers had variance directions [31].

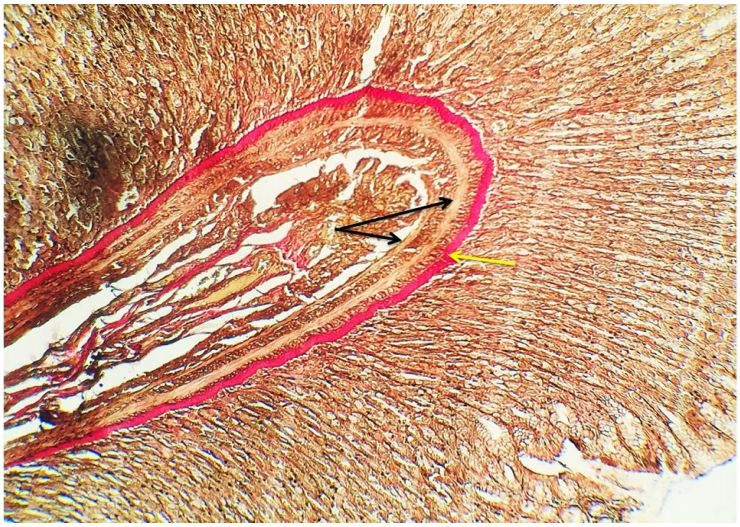
Stratum compactum: the subglandular mucosal layer – stratum compactum mucosae – wasn't really developed, as the one in plenty other carnivore species tested by the above [17]. Opposite to this fact in felines species stomach the layer stratum compactum mucosae was always presented (**Table 1**). Only a few writers [2] have remarked on this specific trait, stating that the cat stomach possesses layer stratum compactum mucosae, whereas it might well be lacking in the dog stomach.

In grey mongoose, observed the layer of stratum compactum appeared as a thick layer, extend beneath mucosa which present a long region of stomach (Figure, 1,2).

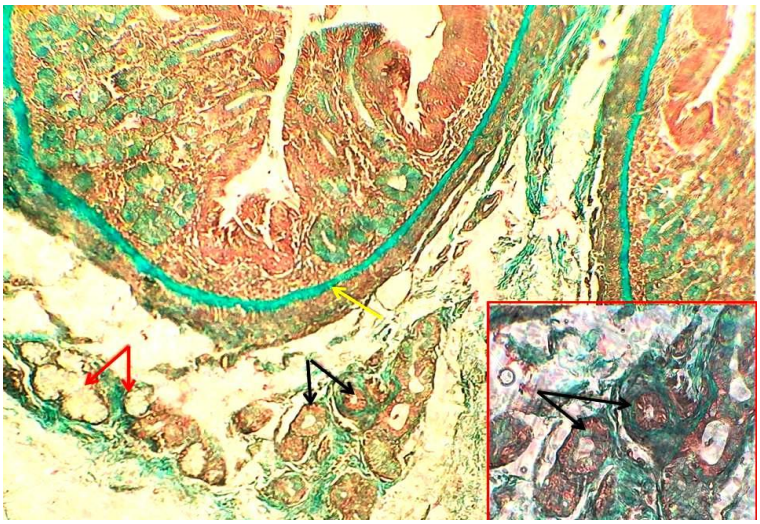
Species	**Total (n)**	**Male (n)**	**Female (n)**	***Stratum compactum mucosae* (µm)**
Dog (Canis familiaris)	15	9	6	-
Fox (Vulpes vulpes)	1	-	1	-
Jackal (Canis aureus)	2	2	-	-

Grey Wolf (Canis lupus)	2	2	-	-
Brown Bear (Ursus arctus)	1	-	1	-
Domestic Cat (Felis domestica)	8	3	5	32.5 – 37.5
Wild Cat (Felis silvestris)	2	1	1	15-25

)Table 1(. Stratum compactum existence layer in stomach mucosa of investigated animals[32].



(Figure: 1). Stratum compactum in grey mongoose (yellow arrows) and two strip of lamina muscularis (Black arrows). Verhoffe stain. 100X. [2].



(Figure: 2). Stratum compactum in abdominal region of gastro-esophagus gate (yellow arrow) Masson's trichrome.100X. [23]

Conclusion

This research highlights the essential histological features of the stomach, particularly in wild animals, and shows that carnivorous stomachs can have a variety of forms. The previous survey also described where the stratum compactum is located in wild animals.

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