Histomorphological investigations of the stomach of wild adult male Rabbits (Oryctolagus cuniculus f. domestica) in AL-Najaf province

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Abstract

Stomach macroscopical and microscopical investigations of ten adult male wild rabbits collected from AL-Najaf city markets recorded to gives a support for future researches and clinical applications as look upon the biology of the digestive system. After rabbit's preparation the stomach recognized then the shape, position, dimensions and its relations with the other abdominal organs were record. The outer shape of stomach is taken J-like shape. Its lies in the cranial part of the abdominal cavity entirely within the rib cage, mostly to the left of the median plane. It consists of the visceral and parietal surfaces, and greater and lesser curvatures. The mean length of the greater and lesser curvatures were (22.3±0.9 cm) and (4.64±0.9 cm) respectively. Stomach connected with spleen, pancreas and colon by thin mesenteric folds. Internal surface of the stomach consist of two parts, glandular and non-glandular. The first part consists of three regions, the cardiac, fundus, and pyloric regions. The mean length of non-glandular and three glandular regions were (2.3 ± 0.38 cm), (2.28 ± 0.4 cm), (6.38 ± 0.23 cm), and (4.3 ± 0.29 cm) respectively. Non-glandular region covered by stratified squamous epithelium. The cardiac and fundus regions covered by simple columnar epithelium. The pyloric region covered by a low columnar to cuboidal epithelium. Invaginations of the glandular epithelium to forms tubular branched and coiled glands. Smooth muscle of muscularis mucosa two layers, tunica submucosa was loose connective tissue, tunica muscularis showed bundles of smooth muscle fibers arrange into internal circular, and external longitudinal layers which facing externally with loose connective tissue of adventitia.

Key words: Histology, stomach, wild rabbits, non-glandular, cardiac, fundus, pyloric

دراسة مجهرية شكلية لمعدة ذكور الأرانب البرية البالغة (Oryctolagus cuniculus f. domestica) في محافظة النجف

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الخلاصة

المصطلحات

الخواص الميكروكيميائية والمجهرية للمعدة بحلة زيادة من ذكور الأرانب البالغة التي جمعت من أسواق مدينة النجف. هذا العمل يُقدّم

دعم للبحث المستقبلي والتطبيقات السريرية القادمة كنقطة على أهمية الجهاز الهضمي. بعد تحضير الحيوان، شُخصت

المعدة. ثم تمّ سجّل الشكل وموقع وقياسات وعلاقة المعدة بالأعضاء البطنية الأخرى. إنّ الشكل الخارجي للمعدة يشبه

حرف (L). وثبّت في الجزء الأمامي للتجويف البطني كلية بين الأعضاء، معضاها إلى اليسار السطح الوسطى. وُتّغت من

السطح الحذوبي والجداري والقوس الكبير والصغير. الطول المتوسط للقياسات كانت (22.3 ± 0.9 سم) و(4.64 ± 0.9 سم) على

التوالي. ترتبّط المعدة بالشرايين وبالنوركياس وبالفولوان بواسطة طبقات مسارقية رقيقة. السطح الداخلي للمعدة

يتكون من مناطق نجدية ولامنة. الأولى تتألف من ثلاث مناطق القلبية والقاع والابوبية. متوسط الطول للمنطقة النجدية

والثلاث مناطق القلبية كانت (3.2 ± 0.2 سم)، (2.28 ± 0.4 سم)، (3.8 ± 0.23 سم) على

التوالي. المنطقة الغريبة مخطَّطة بظهارة حرشفية مطبقة المنطقة القلبية ومنطقة القاع مخطَّطة بظهارة عمودية بسيطة.

المنطقة الابوبية مخطَّطة بظهارة عمودية قصيرة إلى مكعبة. اتباع الظاهرة النجدية، مكونة عند أبوية ونتفرعة ومفتوحة.

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Introduction

There is quite a bit of differences in the digestive systems of various species. The requirements differ considerably between the herbivores, carnivores and the omnivores. Species that are monogastric are quite different from the ruminants (1). The rabbit is a widely distributed animal species, commonly used in the laboratory and for economical purposes, it is a model for numerous medical experiments and extensively used in teaching (2). The rabbit given a separate order because of dentition differences, chiefly the incisors (3, 4). The rabbit is an herbivore designed to exist on a diet of succulent green vegetation (4). Digestive tract of the rabbit is fundamentally different to that of the better known herbivores such as the horse and the ruminant that allows a high food intake, separates out the digestible and easily fermentable components of the diet, and rapidly eliminate the slowly fermentable fibrous waste also have a large absorptive surface area in the large intestine (5). The stomach of the rabbit is a thin walled, J-shaped, and lies to the left of the midline (6). The stomach defined as an enlargement in the anterior part of the GIT at the intrathoracal part of the abdominal cavity. The anatomical features of the stomach of the rabbit are greater curvature (curvatura ventriculi major), convex posterior surface; the lesser curvature (curvatura ventriculi minor), concave anterior surface (4). The main portion or body of the stomach (corpus ventriculi), it lies for the most part to the left of the median plane; the cardia largely covered by the lesser omentum situated at the level of the 4th-5th rib (2). A sac-like expansion of the stomach called fundus. Pyloric (pars pylorica) forms the right portion of the organ, passed through the 7th interrib area, a greatly thickened muscular portion of the pyloric limb known as the pyloric antrum (antrum pyloricum) (7, 8). The wall of the stomach was consisting of four major coats tunica mucosa, tunica submucosa, tunica muscularis, and tunica serosa/tunica adventitia, the gastric mucosa in the rabbit has a surface epithelium of regular columnar mucus-containing cells (9, 10). This epithelium is invaginated to form the gastric pits or foveolae at the bottom of which the gastric glands arise as one or two simple tubules in which are found four cell types, the parietal cells, the zymogene cells, the neck mucous cells, and scattered argentaffine cells, in the fundic glands, the first depth was predominantly composed of parietal cells and the deepest was primarily composed of zymogene cells, and connective tissue of the lamina propria mucosa between these glands (11, 12, 13, 14, and 15). A rich lymphatic capillaries and lymphatics found in the stomach tunic muscularis and tunica serosa. (13). Parietal cells were usually pyramidal with its apex directed towards the lumen in rats (14). In the pyloric regions, the muscularis mucosa was considerably thicker than in the body or fundus (8).

Materials and methods

Anatomical study:
Ten healthy wild adult male rabbits arbitrarily collected from AL-Najaf city markets were utilized in achievement of the anatomical and histological study of the stomach. To induce whole bleeding the animals were anaesthetized with an intramuscular injection of ketamine (35 mg/kg) and xylazine (5 mg/kg) (16) at that time the thoracic cavity were opened and the right atrium were punctured. Five rabbits were employed for each anatomical and histological study. The topographic anatomical description was include recording the stomach position, shape, dimensions and its relations with the other abdominal organs. Subsequently the stomach was separated carefully and evacuated from its contents after incising along the greater curvature, and
identifies the parts of the internal surface. Subsequently measure the length of greater and lesser curvatures, and measure the length of non-glandular and glandular (cardiac, fundic, pyloric) regions of the internal surface of the stomach.

**Histological Study:**
Five specimens of stomach were dissected out and washed with normal saline solution, and dissected into four parts (non-glandular, and glandular (cardiac, fundus, and pyloric regions)), and puts in special casket and fixed immediately with neutral buffer formalin (NBF10%) at room temperature. The routine histological technique were performed (17) using 1-digital tissue processor encompassing a- Dehydration using seven serial steps of deferent concentrations of ethanol, two hours for each step. b- Clearing by two steps of xylene, one hour for each step. c- Impregnation by two steps of melted paraaffin wax (58-60 °C) two hours for each step. 2-Semi digital embedding center: contain special molds for formed wax blocks. 3-Semi digital rotary microtome: Sectioning measures 5-micrometer thickness. 4-Staining by:- Harris Hematoxylin and Eosin stain as routine stain to demonstrate the general histological structure, and Periodic Acid-Shiff (PAS) Stain to demonstrate the type of glands secretions.

**Results**

**Anatomical results :**
Anatomical investigation of the stomach of the adult male rabbit appeared as J-shaped during filling with foods (Fig.1). It lied at the cranial part of the abdominal cavity entirely within the rib cage, mostly to the left of the median plane. Stomach consist of body (greater part of the stomach), cardiac region and cardia (opening at the esophagus junction), and pyloric region and pylorus (point communication of the stomach with the duodenum). Stomach contains two convex surfaces the visceral surface opposed to the duodenum, ileum, and pancreas; and parietal surface against the liver and gallbladder, which caused impression in visceral surface of liver. Addition to that stomach of rabbit characterized by the greater convex curvature was very extensive, extending from the cardia the first directed dorsally and curves over the left side (body); then descends passes to the right, crosses the median plane, and curves upward to end at the pylorus. Its left part related to the spleen, while its ventral portion rests on the left parts of the great colon. The lesser concave curvature, was very short, extending from the termination of the esophagus to the junction with the small intestine which against visceral surface of liver, pancreas, and duodenum of small intestine (Fig. 1 and 2). The mean length of the greater and lesser curvatures were (22.3±0.9 cm) and (4.64±0.9 cm) respectively. The stomach connected with spleen by thin smooth gastrospenic fold, passes from the left part of the greater curvature to the hilus of the spleen. In addition, with pancreas by gasteropancreatic fold extends from the left sac above the cardia to the duodenum. Moreover, with colon by gastrocolic fold connects the ventral part of the greater curvature and the first curve of the duodenum with the terminal part of the great colon and the initial part of the small colon (Fig. 1). Internal surface of the stomach grossly distinguished by two regions, non-glandular region extending of the esophagus at the cardia to small area was light gray and harsh to the touch, and glandular region extending from the non-glandular ending to the pyloric orifice. The later may be include three regions cardiac region come into view smooth pale pink-color closer proximity to cardiac orifice, fundic region showed darker than the cardiac region and demonstrated by several folds variable directions, and pyloric region emerged as white-yellowish appearance connected with the duodenum of small intestine by pyloric orifice (Fig. 3). The mean length of four gastric regions were (2.3 ± 0.38 cm), (2.28 ± 0.4 cm), (6.38 ± 0.23 cm), and (4.3 ± 0.29 cm) respectively.
Fig. (1): Parietal view of the stomach of the adult male rabbit demonstrating: Esophagus (a), cardia (b), body (c), pyloric region (d), pylorus (e), duodenum (f), Greater curvature (g), lesser curvature (h), Spleen (i), gastroplenic fold (j), parietal branches of the left gastric artery (k).

Fig. (2): Ventral view of the abdominal cavity of the adult male rabbit demonstrating parietal surface of the stomach: parietal branches of the left gastric artery (a), cardia (b), body (c), pyloric region (d), pylorus (e), Greater curvature (f), lesser curvature (g), liver (h), small intestine (jejunum) (i).
Fig. (3): Internal surface of the stomach of the adult male rabbit demonstrating: Cardia (a), Nonglandular region (b), Cardiac region (c), fundic region (d), longitudinal folds of the fundic region (e), pyloric region (f), pylorus (g), duodenum (h).

Fig. (4): Cardiac region of the stomach of the rabbit demonstrating: openings of cardiac glands (pits) (a), consist of mucous cells (b), smooth muscle fibers of the internal circular layer of the muscularis mucosa (c). PAS stain X200
Fig. (5): Fundic region of the stomach of the rabbit demonstrating: Lumen of the stomach (a), fundic glands (pits) consist of mucous neck cells (black arrows), parietal cells (white arrows), chief cells (empty circles), smooth muscle fibers of muscularis mucosa (circular layer) (b), submucosa (loose connective tissue) (c), smooth muscle fibers of tunica muscularis (d). H & E stain A X40

Fig. (6): Pyloric region of the stomach of adult male rabbit demonstrating: simple low columnar to cuboidal epithelium (a), opening of gastric glands (b), branched and tubular glands (c), mucous cells (d), myofibers of circular layer of muscularis mucosa inter between two adjacent glands (black arrows), circular layer of muscularis mucosa (white arrows ), submucosa loose connective tissue (e), thick circular layer of tunica muscularis (f). H & E stain X40 (Magnified)
Histological results

Microscopical examinations of the four regions of the internal surface of the stomach in this study of the adult male rabbits noticed esophagus mucosa continues at cardiac orifice and nonglandular region which covered by stratified squamous epithelium. Epithelium that a lined cardiac and fundic region was making up of simple columnar epithelium basally located oval nucleus and abundant apical cytoplasm (Fig. 4 and 5). While epithelium of pyloric region was simple, low columnar to simple cuboidal epithelium with basal or central nuclei (Fig. 6). Epithelium of the glandular portions of the stomach was invaginate into the lamina propria to form gastric pits or foveolae. Orifice of each pit represented opening of gastric gland, which branched, tubular glands (Fig. 6). At the first portion of the gland of the glandular parts of the stomach, there were low columnar to cuboidal mucous cells smaller and darker than the surface mucous cells with central round nucleus, which gave the positive reaction with the (PAS) stain (Fig. 4,5, and 6). In the fundic region addition to mucous cells there were large, triangular, central nuclei, acidophilic cytoplasm cells called Parietal cells, apex toward the lumen of glands were scattered among mucous cells and large, basal nuclei, pale cytoplasm cells called chief cells, which concentrated in the bottom of these glands (Fig. 5). Mucous cells as predominantly cells at cardiac and pyloric regions (Fig. 4, and 6). Depth of the glands of the fundic portion was more than the cardiac glands, while the later deeper than the pyloric glands. The space between two adjacent bits filled by lamina propria and some smooth muscle fibers of the internal layer of the muscularis mucosa, which consist of internal circular and external longitudinal layers, the inner circular muscle layer at the esophagus and cardiac region junction was development forms the cardiac sphincter. Tiny submucosa layer was loose connective tissue. Tunica muscularis showed bundles of smooth muscle fibers arrange into internal circular layers, and external longitudinal layers the inner circular layer at the pyloric region and duodenum junction was development forms the pyloric sphincter. Tunica muscularis which facing externally to the loose connective tissue of adventitia which contain lymphocytes, arterioles, venule and adipose tissue.

Discussion

The present anatomical results of the stomach in the rabbit revealed that the external shape and position of it were fully confirmed to the finding (6). Addition to that position and relations of stomach obviously depend on the degree of fullness (18). The stomach curvatures and they shaped were harmonized with (4). The dimension of the greater curvature longer than the lesser one about five times this gave the J-shaped of the stomach and inclined it toward right side of abdominal cavity. That referred to the main portion of the stomach lies for the most part to the left of the median plane (2). According to color and texture, the internal surface regions of the stomach easily distinguished by naked eye. Type of mucosa, thickness of the wall, and function of each part of the stomach may give these color and texture. Furthermore, cardiac region limited in swine but expanded in horse in which it lines the saccus cecus and this region markedly expanded in ruminant where it lines the fore stomach, when it was empty, stomach decrease lead to several longitudinal folds appeared especially at the body (large part of the stomach) (fundic glandular region internally), that allow the stomach volume to expand accumulate meals (19). Nonglandular region continuation of esophagus in target animals lined by stratified squamous epithelium was large proportionally for size of stomach. These consequence uncoincided with (6) who postulated that the stomach completely glandular in Cavies, and with (20) who said the mucosal surface epithelium of the esophagus changes from ciliated pseudostratified to a simple gastric epithelium in Rana perezi. Surface mucous cells of glandular stomach of target animals were simple columnar epithelium these outcome inconsistence with (20) who assumed that these regions covered by simple cuboidal epithelium in Rana perezi.
Profundity, shape, and secretions of the gastric glands, different among three regions. Proportionally, short branched tubular cardiac and pyloric glands, and long branched, tubular and coiled fundic glands. The finding incongruity with (18) he supposed the fundic glands were simple tubular glands in horse, and (20) who postulated that the stomach glands of *Rana perezi* were mostly of a simple type straighten towards the stomach and two regions found, fundic, and pyloric; glands of the fundic were shallower than the pyloric, and the caudal end of the pyloric region has a few short glands. In addition, cells of glandular regions of the stomach of the rabbit were variable, which referred to functions of each part. Fundic glands were true glands secretion because they contain parietal (secrete acid and intrinsic factor) and chief cells (secrete pepsinogen) addition to the mucous cells, while cardiac and pyloric the mucous cell were predominant therefore major secretion was mucous. These interpretations nearly confirmed with (6) in rabbits and (18) in horse. The muscularis externa were thick at the cardiac and pylorus orifices led to active sphincters, serve at cardiac region as prevents vomiting(6).

**References**