Impact Factor: 9.2 ISSN-L: 2544-980X

Modern Functional Diagnostics in the Study of the RAT Stomach

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Abstract: Postnatal development determines the formation of anatomo-topographic relationships of internal organs and inter-organ interactions in humans and animals. Anatomo-functional activity of organs during overload determines adequate morphogenesis by changes in absolute and relative growth.

Key words: functional diagnosis, morphology, rats, stomach.

Introduction: Individual development with morphogenetic correlations, determine the overall structure of the organism during its development. According to (L.V. Vinokurov et al., 2015) mammalian stomach, differs significantly, in different animal species in different ways, although it has basic structural similarities. According to scientists, the general morphology largely depends on the nature of food and frequency of ingestion. Research V.M.Petrenko (2013) between two sections of the stomach there is a well-defined bridge. Food enters first under the stomach, where it is fermented by acids and microorganisms. The author divides the organs into a translucent, pale whitish mucous membrane, the cardiac part, and an opaque muscular part, the pyloric part.

V.B. Salamov et al. (2021) believe that the largest, most variable part of the stomach is the pre-stomach (esophageal part), which increases in size as the organ fills up due to stretching of the walls, performing the function of a receptacle. The stomach of white rats is located almost transversely with respect to the sagittal and horizontal planes. According to V.G.Grin (2017). This condition in humans is found in pathology, lowering of the stomach with a low location of the cardiac part.

Literature data show that normally the stomach of the white rat is more curved, has a relatively constant hook-shaped shape. In the process of ingestion and accumulation of food in the stomach, it increases in size due to stretching of the serous membrane. In spite of the similarity of the structure, shape and location of the mammalian stomach and human stomach, there are distinctive features. But in the literature the age dynamics of growth, development and regularities of location, and macroscopic structure of the rat stomach in the periods of postnatal ontogenesis are insufficiently studied.

Objective of the study. To study anatomico-topographic peculiarities of rat stomach structure using functionally diagnostic methods of investigation.

Materials and methods of the study: The work was carried out on 63 unbred rats. Rats were kept in usual conditions of the vivarium: relative humidity (50-60%), temperature (22°C), light regime (12 hours of darkness and light each). All laboratory animals were white mongrels obtained from the same cattery. They were divided into 5 groups (n=96). 1.Group - one-month-old rats (n=11). 2. group- 3-month-old rats (n=14). 3. group - 6-month-old rats (n=13). 4. group - 9-month-old rats (n=11).and 5. group - 12-month-old rats (n=14).

The rats were decapitated against the background of inhalation general anesthesia with isoflurane.Routine sectional removal of the anterior chest and abdominal cavity wall and photographing of their contents were performed. After that, traditional anatomical dissection was resorted to, which consisted in the extraction of the stomach from the abdominal cavity. Morphometric measurements were carried out using calipers (in cm) and the length of the stomach was measured at the levels of the odontated points of the fundus and pyloric region. The width of the organ was measured at the levels of the fundus, body and pyloric region of the organ.Large and small curvature of the stomach was measured. At the level of small curvature of the stomach two openings were revealed - esophageal (at the level of stomach body) and duodenal (at the level of pyloric sphincter), distances between openings were measured, and also the length of abdominal part of the esophagus was measured in cm.

Ultrasound study determined the borders of rat abdominal cavity in the age aspect, which is bordered: from above by rib arches, from below by iliac crests, pelvic bone, inguinal ligaments and upper edge of pubic junction - symphysis. The lateral border runs along the vertical lines connecting the ends of the ribs with the anteroposterior axes, where the volume of the abdominal cavity in rats is revealed (cm3).

Fluoroscopic examination of the stomach of rats by introducing an aqueous suspension of barium sulfate (through a thin probe) into the lumen of the stomach of animals, through the esophagus into the stomach and giving a complete picture of the character of elevations, depressions and other features of their mucous membrane on the screen. The internal relief of the stomach is studied to determine the shape, size, and position of the organ.

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In the study of the stomach volume (cm3) of rats in different age groups we used Archimedes' law of fluid statistics in the stomach cavity, through the esophagus we injected water with a probe while the second opening - the pyloric sphincter of the stomach was covered with surgical tweezers. On the liquid, an expulsive force equal to the weight of the volume of liquid displaced by the part of the body immersed in the liquid acts.

Formula; Fb=rgV; Fb=Arhimedian force; P=density of liquid

g=acceleration of gravity; V=volume of liquid.

Statistical processing of morphological data was made directly from general matrix of MicrosoftOffice data program package "Excel 7.0" on personal computer Pentium-IV using possibilities of "STTGRAPH 5.1" program to determine indices of standard deviation and error of representation.

Results and discussion. On ultrasound examination of the abdomen during postnatal ontogenesis, the borders of the rat abdomen are limited from above by the rib arches, from below by the iliac crests, inguinal ligaments and the upper edge of the pubic joint. The lateral borders of the abdomen run along the vertical lines connecting the ends of the XII ribs with the anterior superior spines (Fig.1).

Fig.1. Ultrasound examination of the rat abdominal cavity in the postnatal period of development.

The volume of abdominal cavity in one-month-old rats averaged 3.20±0.07 cm3, by the age of 12 months averaged 4.9±0.09 cm3. The coefficient of stomach capacity in one-month-old rats averaged 9.10±0.79%. At 12-months of age this coefficient was 7.11±0.23%. For topographic-anatomical studies of the borders and regions of the abdomen in rats there were two horizontal lines: the upper intercostal (lineacostarum) and lower intercostal (lineaspinarum), thus the abdominal wall of rats was divided into three regions: the upper epigastric, middle - mesogastric and lower - hypogastric, to reveal the place of the stomach location in these regions of the abdomen. According to D.K. Khudoyberdiev et al. (2020), the stomach of the white rat is a sac-shaped formation of the digestive tract, which is located in the upper floor, in the anterior part of the abdominal cavity, most of this organ is to the left of the midline.

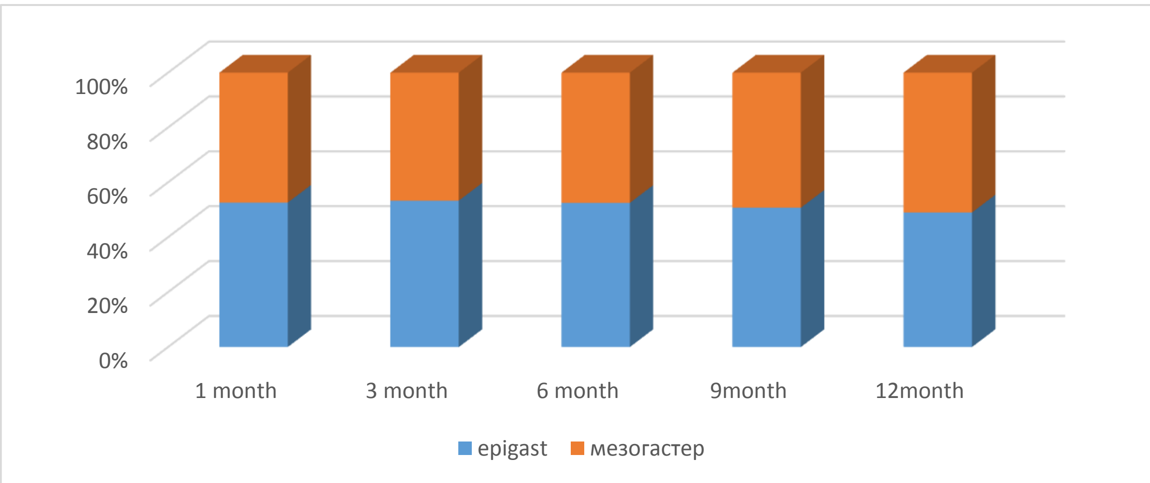

Fig. 2. Location of the rat stomach in the abdominal cavity.

Figure 2 shows the proportion of the rat stomach located by region in the abdominal cavity. With transition to coarse diet in one-month-old rats, the stomach is located in the epigastric region of the abdomen and averages - 1.80±0.04 cm, in the mesogastric region averages 1.62 - 0.04 cm. By the 12th month of life, the stomach is located in the upper floor of the epigastric region of the abdomen and averages 2.40±0.03cm, the average floor of the mesogastric region is 2.50±0.05cm3. Location of the stomach of the 3-month-old rat in the abdominal cavity (Fig. 3).

Fig. 3. Location of the stomach of the 3-month-old rat in the epigastric region of the abdomen.1. Pyloric part. 2. The body of the stomach. 3. Stomach floor. 4. Large curvature.

The anterior lower surface of the rat stomach is in contact with the diaphragm and for the most part with the abdominal wall and the small part covered by the left lobe of the liver. The posterior upper surface is located below the liver at the level of the body of the organ on the right side is the spleen on the left side of the pancreas behind the peritoneal space. It is relatively in the left side of the abdomen at the level of the XI and XII thoracic vertebrae, dorsal to the liver and the long axis of the stomach is directed transversely to the sagittal plane.

Fluoroscopic study of the rat stomach studied the internal relief of the stomach to determine the shape, size, position of the organ.According to A.Yu.Savelyev (2018) the rat stomach has a hook shape, also found horseshoe-shaped stomachs Cardial section of the stomach has tubular glands, the secret of which has no enzymes. The bottom of the stomach occupies most of the stomach, its glands secrete pepsinogen and hydrochloric acid. The gatekeeper's part is the stomach, which produces a mucous secretion.

Research A.D.Nozdracheva et al. (2016) found that due to the muscular layer, the stomach stirs food, forming chyme, which is removed in separate portions from the stomach through the gateway canal. The authors indicate that, depending on the consistency of the incoming food, it lingers in the stomach from 20 minutes (juices and broths) to 6 hours (meat dishes).

Fluoroscopic examination revealed that one-month-old rats have the smallest stomach shape in the form of a stocking and a hook - 18.2%, the largest in the form of a horseshoe and a shoe - 36.4% and 27.2%, respectively. By 3-months of age, the shape of the stomach is least as a hook-14.3%, most as a horseshoe-42.8%, less frequently as an anchor-7.2%. Fluoroscopic examination of the stomach of 3 - month old rats in the form of a shoe (Fig. 4.).

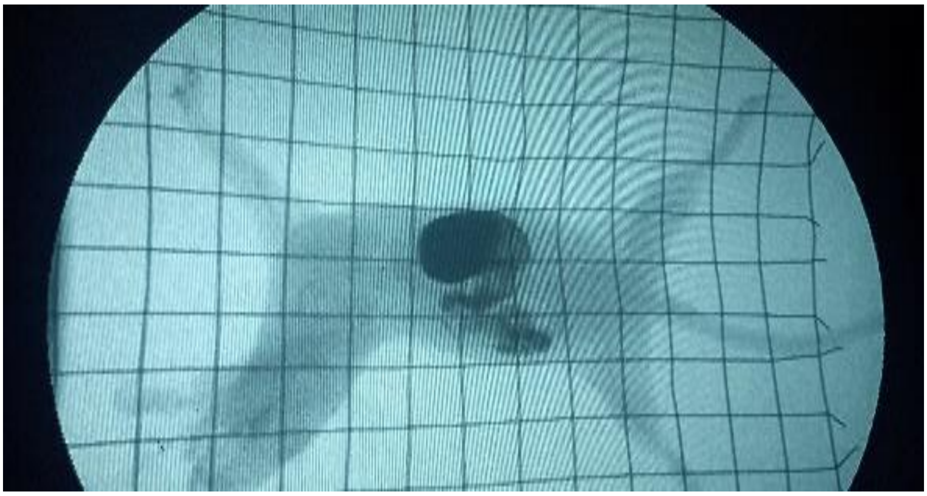

Fig.4. Fluoroscopy of the stomach of a 4-month-old shoe-shaped rat. 1. Bottom of the stomach. 2. The body of the stomach. 3. The pyloric part of the stomach. 4.The small curvature. 5. Large curvature.

At 6 months of age, the shape of the stomach of rats was the greatest in the form of a horseshoe-27.2%, a shoe-38.5% and less frequently in the form of an anchor-15.3%. By 9 months of age, the shape of the stomach is more often in the form of a horseshoe - 54.7%, a shoe - 33.3% and less often in the form of an anchor - 18.1%. Radiographic stomach of 9-month-old rats is anchor-shaped (Fig. 5).

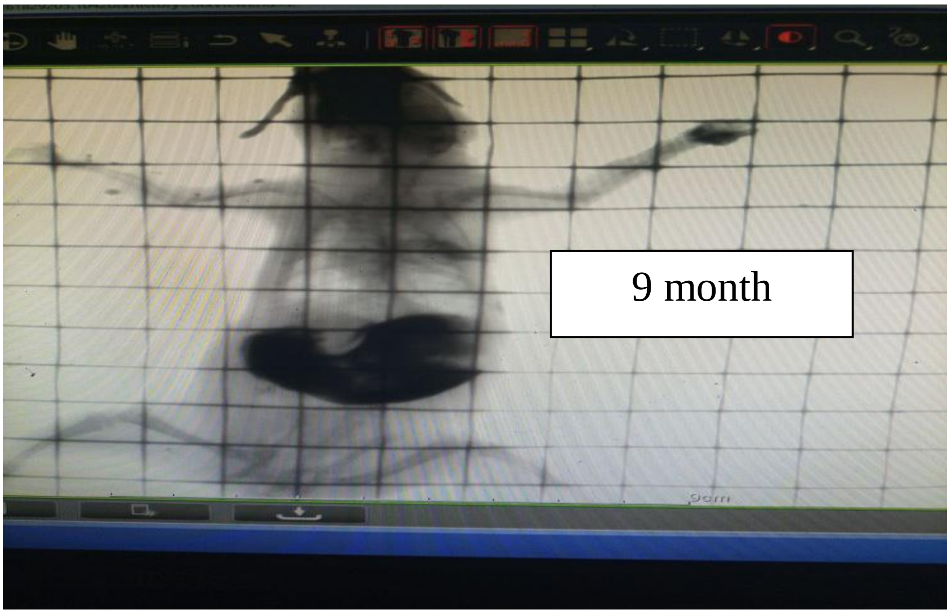

Fig.5. Radiographic stomach of 9-month-old rats with an anchor shape. 1. Stomach floor. 2. The body of the stomach. 3. The pyloric part of the stomach. 4.The small curvature. 5. Large curvature.

Stomach of rats with transition to coarse diet by 12-months of age its shape is often in the form of - 33.3%, in the form of a shoe - 41.7% and in the form of an anchor - 25.0%. Fluoroscopic examination of the stomach in 12-month-old rats in the form of a horseshoe (Fig.6.).

Fig.6. Fluoroscopy of the stomach of rats at 12 months of age, horseshoe shape. 1. Stomach floor. 2. The body of the stomach. 3. The pyloric part of the stomach. 4.The small curvature. 5. Large curvature.

To obtain reliable data, X-ray of the stomach of rats in the period of postnatal ontogenesis, by introducing an aqueous suspension of barium sulfate (through a thin probe) into the lumen of the stomach of animals, by swabbing their internal walls along the esophagus into the stomach. The shape, size and location of the rat stomach during the period of postnatal ontogenesis were revealed. Shapes of the rat stomach in the period of early postnatal ontogenesis(Fig. 7). In rats, according to the location of the stomach, three sections are distinguished: the fundus - facing the diaphragm, the body - facing the abdominal wall, and the pyloric section - facing the liver gates.

The length of the stomach of one-month old rats is on the average - 0,99±0,04 cm, in the period of postnal development with age the length of the stomach increases and to the 12-month age of rats the organ length is on the average - 3,15±0,05 cm. Width of the stomach in one-month old rats at the level of organ bottom is on the average - 0,43±0,03 cm, at the level of body - 0,73±0,05 cm, at the levels of pyloric part - 0,74±0,06 cm. With age the increase of the stomach width in rats was revealed and by 12 months of age the stomach width at the level of the floor was on the average - 2,04±0,09 cm, at the level of the stomach body - 2,82±0,09 cm, at the level of the pyloric gastric region - 2,16±0,08 cm

Transparent and opaque parts of the stomach, separated by a low tissue, vertically limiting ridge, which runs just below the esophageal-ventricular junction on the circumference of the large and small curvature of the stomach. The transparent part is the anterogastric part of the rat's stomach, which receives food and serves as a receptacle for it. The length of the transparent part of the stomach in one-month old rats averaged 0.70±0.004 cm. By 12-month age, the length of the transparent part of the organ was on the average 2.69±0.05 cm.

Anatomical landmark, two regions of the rat stomach (J.M. DeSessoetall., 2001) limiting ridge, which closes the opening from the esophagus and prevents the possibility of vomiting in rodents. In contrast, E.L. Polyakov et al. (2012); Sh.J. Teshayev, E.A. Kharibova (2020) believe that the mucous membrane of the human stomach is completely lined by glandular epithelium and provides secretory function in all sections. Figure 7 shows the transparent and opaque part of the stomach of a one-month-old rat.

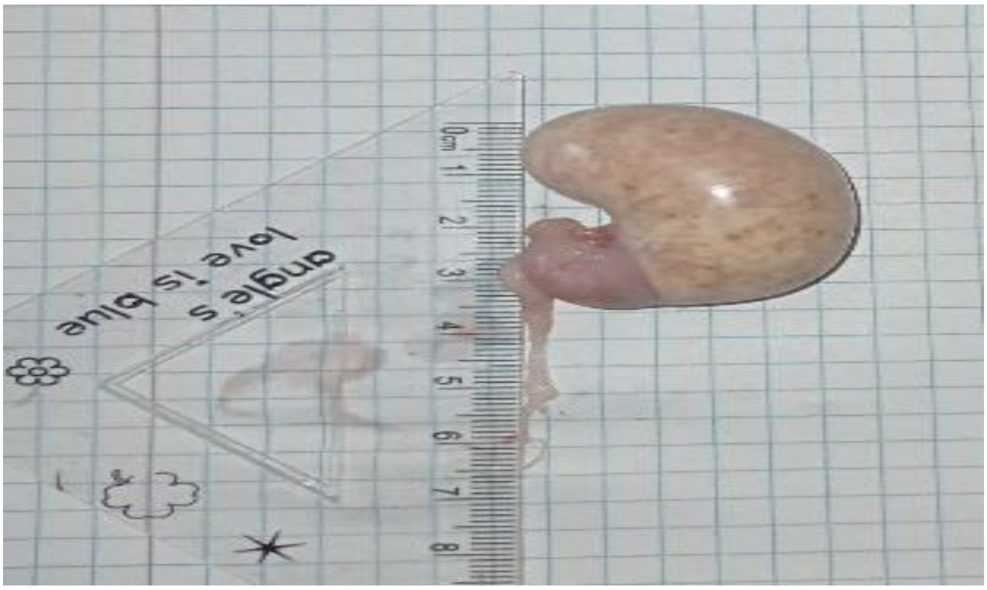

Fig.7. Transparent and opaque part of the stomach of a one-month-old rat.1. Transparent part. 2. Opaque part. 3. Comb. 4. The abdominal part of the esophagus.

Opaque part of the organ is a relatively small part of the stomach, which is located on the right side in relation to the transparent part of the stomach, it does not have a pronounced pyloric sphincter, which controls the movement of food from the body of the stomach into duodenum. According to V.M. Petrenko (2013) and M.N. Makarova et al. (2016), food when entering the stomach of rats is deposited without the glandular part of the stomach. The author believes that the part of the stomach, near the exit into the duodenum, is the glandular part, where the secretory part of the epithelium is located. The internal part of the human stomach differs from that of the rat in that the entire organ is lined with secretory epithelium without the glandular part, and there is no limiting ridge. The large curvature of the rat stomach is distal and downward, it faces the anterior abdominal wall and is relatively more mobile than the small curvature. In one-month old rats, the length of the large curvature is on average 1.98±0.07 cm. By the end of late postnatal development, the length of the large curvature is on average 3.52±0.14 cm in the 12th month of life. Small curvature is proximal to the liver and from above it faces the vertebral column. The length of the small curvature in one-month old rats averaged 0,033±0,01 cm and by the age of 12 months the length of the small curvature of the stomach of rats averaged 6,62±0,10 cm. Table 1 shows the width and length of the stomach in different parts of the organ and the sizes of the small and large curvature.

Table 1. Parameters of the rat stomach in late postnatal ontogeny

Age	**Width**			**Length**	Curvature	
	Bottom	**Bodies**	Curvature	Little Big	Little	Big
1 month	1,7-2,7 2,17±0,10	2,4-3,5 2,99±0,11	1,8-2,9 2,32±0,11	3,0-3,8 3,42±0,08	0,83-1,08 0,95±0,03	6,6-8,58 7,52±0,20
3 month	1,8-2,9 2,24±0,09	2,6-3,6 3,14±0,08	1,9-3,0 2,47±0,09	3,1-4,0 3,56±0,07	0,86-1,11 0,99±0,02	7,44-9,6 8,54±0,18
6 month	2,1-3,4 2,69±0,11	3,1-4,2 3,66±0,10	2,2-3,5 2,82±0,11	3,5-4,6 4,00±0,10	0,97-1,24 1,08±0,02	8,64-11,04 9,60±0,21
9 month	2,3-3,8 3,10±0,15	3,3-4,4 4,01±0,11	2,4-3,9 3,03±0,15	4,0-5,0 4,49±0,10	1,08-1,35 1,24±0,03	10,0-12,5 11,23±0,25
12 month	2,6-4,0 3,52±0,11	3,5-4,6 4,34±0,09	2,7-4,0 3,31±0,11	4,5-5,5 4,9±0,08	1,31-1,57 1,40±0,02	12,4-14,0 13,2±0,13

It is known that the stomach of rodents, has two completely different, well-defined parts. The anterior part of the stomach is lined with multilayer epithelium, where the exit from the esophagus and the bacterial digestion site are located. The glandular part of the stomach is lined by secretory epithelium, which provides synthesis of acid and enzymes (M.N. Makarova et al., 2016).

In rats during late postnatal ontogenesis, the abdominal part of the esophagus opens in the middle of the small curvature of the stomach, forming the entrance to the stomach. The mucous membrane of the esophagus curving in the form of a scallop in the one-month-old rat, they completely surround the esophageal opening, passing into the mucosa of the stomach (Fig. 8).forming a high esophageal-ventricular ridge.

Figure 8. Esophageal-ventricular flap in rats. 1. Esophageal-ventricular flap. 2. Gastric mucosa. 3. The muscular lining of the stomach. 4. The ridge between the transparent and opaque part of the stomach.

In one-month old rats, the length of the abdominal part of the esophagus averaged 0.16±0.01 cm. By 12 month of life the length of abdominal part of esophagus of rats is on the average 0.33±0.001 cm.

Along the small curvature on the right at some distance from the esophageal opening there is the second opening - the pyloric part of the stomach, where the pyloric sphincter of the rat stomach is located, passing into the initial part of the duodenum. The distance between two openings of the stomach in one-month-old rats is on the average - 022±0.01 cm, in 12-month-old rats it is on the average - 0.60±0.01 cm.

The capacity of the stomach in one-month-old rats averaged 0.29±0.02cm3, of which the transparent part averaged 0.21±0.01cm3, the opaque part 0.08±0.01cm3. By 12 months of age of rats, the capacity of the stomach was on the average - 1,30±0,05 cm3, of them the transparent part was on the average - 1,11±0,04 cm3, the opaque part - 0,19±0,01 cm3. Abdominal cavity capacity and gastric capacity factor in rats in late postnatal ontogenesis (in Table 2).

Table 2. Stomach capacity of rats in late postnatal ontogenesis

Age	Capacity (cm3)	Abdominal volume (cm3)	Gastric capacity factor in the abdomen (%)
1 month	1,5-2,57 2,15-0,11	8,0-14,0 10,27-0,60	14,38-25,00 21,37-1,06
3 month	2,88-3,66 3,26-0,06	22,51-24,62 23,27-0,17	12,22-15,86 14,01-0,30
6 month	3,32-4,17 3,69-0,07	26,52-29,33 23,07-0,24	13,95-18,49 16,04-0,39
9 month	4,24-5,24 4,72-0,10	30,06-33,04 31,50-0,30	13,4-16,1 15,0-0,27
12 month	4,62-6,29 5,44-0,14	40,9-43,2 42,1-0,19	11,3-14,7 12,9-0,28

Conclusions: Thus, in the period of late postnatal ontogenesis the parameters of the stomach increase by one month of age of rats with the transition to a rough diet the stomach increases in size due to the increase in the large curvature of the stomach, when the stomach of rats is filled it hangs over the abdominal part of the esophagus and pyloric part of the duodenum, which is in the small curvature. In our opinion, a great variety of forms of the rat stomach in early postnatal ontogenesis is connected with omnivorousness and a variety of types of feeding. The floor of the stomach when the organ is empty is somewhat cranial adjacent to the diaphragm; when the stomach is full, it is somewhat downward, due to an increase in the large curvature and the floor of the organ, which hangs down and forward toward the abdominal cavity.

Literature:

1. Ilyasov A. S., Sharifova Sh. K. Effects of industrial toxicants on the structure of the retal intestinal wall of the rat International journal of innovative analyses and emerging technologye-issn: 2792-4025 | http://openaccessjournals.eu | volume: 1 issue: 6 ISSN 2792-4025 (online), Published under Volume: 1 Issue: 6 in November-2021 Copyright (c) 2021 Author (s). This is an open-access article distributed under the terms of Creative Commons Attribution License (CC BY).To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/58
2. Ilyasov Aziz Saidmuradovich, Djumaeva Khikoyat Sharipovna, Spleen morphology and pancreas of rats and its changer under alcoholic intoxication, Scholar express journals, 2021

3. А.Ю.Савельева. Практикум по анатомии декоративных и экзотических животных. Красноярск 2018. С 281.
4. В.Б.Саламов, Ш.Ж.Тешаев, У.В.Бафоев. Особенности анатомических параметров и топографии желудка белых крыс. – 2021.№1(125).
5. .Г.Гринь. Макромикроскопические особенности рельефа слизистой оболочки желудочно-кишечного тракта белых крыс. // Світ медицини та біологи. 2019. №2. – С. 38-40.
6. В.М.Петренко. Форма и топография желудка у морской свинки// Успехи современного естествознания -2013д, №11, -С. 69-72.
7. Д.К.Худойбердиев, Ш.Ж.Тешаев, Р.Р.Наврузов. Морфометрические особенности стенки желудка белых крыс в раннем постнатальном онтогенезе// Проблемы биологии и медицины. - 2020. №5. Том. 122. - С. 231-234.
8. Д.К.Худойбердиев. Влияние факторов внешней среды на морфологию желудка// Проблемы биологии и медицины. 2019, №3 (111). - С. 295-296
9. Е.В.Петренко. Сравнительная анатомия желудка человека и грызунов // Международный журнал прикладных и фундаментальных исследований. -2016. - №3-2. С. 255-258.
10. Л.В.Винокурова, М.А.Агафонов, Г.Г.Варванина и соавт. Биллиарная недостаточность при различных этиологических формах хронического панкреатита // Gastroenterology. -2015, №2 (103). –С. 14-18.
11. М.Н.Макарова и соавт. Анатомо-физиологическая характеристика пищеварительного тракта у человека и лабораторных животных, Международный вестник ветеринарии, № 1, 2016 г., Стр. 82-108.
12. Т.О.Даминов, Л.Н.Туйчиев, Г.К.Худайкулова и соавт. Биохимический состав желчи у реконвалесцентов гепатита А // Детские инфекции. 2012, №4. –С. 57-60.
13. Ш.Ж.Тешаев, Е.А.Харибова. Одам анатомияси Атлас 2-том издательство “Би Ту Би “Ташкент. 2020. -660с.
14. MLVasyutina, SVSmirnova. Sravnitelnyyanalizpreparatov, ispol'zuyemykhdlyaobshcheyanesteziiukrys. Vestniknovgorodskogogosudarstvennogouniversiteta. 2015;86 (1):41-43. [in Russian]