Gastric Structure of Rats During Early Postnatal Ontogenesis

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ABSTRACT

Structural and organizational rearrangements occurring rapidly in the structure of the rat stomach in early postnatal ontogenesis, which enable us to take into account all the nuances when performing surgical surgery and reconstructive measures of the abdominal cavity organs in this case of the rat stomach. The last mentioned circumstance acquires great topicality, in particular, when carrying out preventive measures, such as prevention of possible complications after trauma. These data give us grounds to think about the necessity of profound research of structural and functional mechanisms of changing anatomico-topographic peculiarities of the stomach development of laboratory animals in norm.

Experimental models of research on animals are of great importance in clinical medicine. When transferring the obtained experimental data from animals to humans, there are difficulties associated with the difference in anatomy and function of the organs.

Keywords: Rats, stomach, abdominal cavity, stomach capacity, stomach shapes, lesser and greater curvature

Introduction. The greatest number of drugs are dosage forms intended for oral administration (orally), therefore, the study of the structure of the gastrointestinal wall is of great practical importance in medicine (Makarova M.N. et al., 2016). According to scientists it is a careful approach to the comparison of the digestive system in laboratory animals and humans and is of great importance in practical medicine.(Ilyasov A. S., Sharifova Sh. K 2021)

According to (L.V. Vinokurova et al., 2015) the mammalian stomach differs significantly, in different animal species in different ways, although it has basic structural similarities. According to scientists, the general morphology is largely dependent on the nature of the food and the frequency of eating. According to scientists the volume of an empty stomach in man is about 0.5 litres. After a meal, it usually stretches to 1 litre, but can increase to 4 litres. The authors believe that in humans the stomach is divided into the following sections: cardiac, fundus, body and pyloric section of the organ.

According to V.M. Petrenko(2013) and M.N. Makarova et al. (2016) food when entering the stomach of rats is deposited in the gland-free 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 inside of the human stomach differs from that of the rat in that the entire organ is lined with secretory epithelium and there is no glandular part, nor is there a limiting ridge.

According to A. Savelyev (2018) the rat's stomach is hook-shaped and there are also horseshoe-shaped stomachs. According to the scientist, the rat's stomach is mostly located to the left of the midline, is covered ventrally by the liver and has four sections: the oesophageal (pre-stomach) is the part of the stomach functionally used for storing and digesting food. The cardiac part of the stomach has tubular glands whose secretion has no enzymes. The floor of the stomach occupies most of the stomach, its glands secrete pepsinogen and hydrochloric acid. The pylorus is the part of the stomach that produces a mucous secretion (IlyasovAS, TursunovaSh.M. 2021).

According to V.M. Petrenko (2013) there is a well-defined bridge between the two parts of the stomach. Food enters the pancreas first, where it is fermented by acids and microorganisms. The large curvature of the stomach borders the pancreas and spleen. In an overcrowded state, the size of the stomach can reach the size of the main, glandular stomach. The author divides the organs into a translucent, pale whitish mucous membrane - the cardiac part and an opaque muscular part - the pyloric part (D.K. Khudoyberdiev et al., 2020; Sh.Zh. Teshayev et al., 2020).

The stomach of white rats is located almost transverse to the sagittal and horizontal planes. According to V.G.Grin(2017). This condition in humans is found in pathology, the prolapse of the stomach with a low cardiac location.

Normally, the long axis of the human stomach goes from the left top and back right down and forward and is almost in the frontal plane (E.V.Petrenko, 2016;D.K.Khudojberdiev, 2019).

According to E.V.Petrenko(2016) the stomach of the white rat has the following features: Large steep and small short curvature. A narrow oesophagus opens in the middle of the small curvature. The author believes that in humans the oesophagus opens in the region of the cardia and has the smallest distance between the entrance and exit orifice of the stomach.

Literature data show that the stomach of the white rat is normally more curved and has a relatively constant hook-shaped shape. In the process of ingestion and accumulation of food in the stomach it increases in size by stretching the serous membrane. In spite of the similarity of the structure, shape and location of the stomach of mammals the stomach and the human stomach have distinctive features.

But literature data insufficiently studied the age dynamics of growth, development and regularity of the arrangement and macroscopic structure of the rat stomach in the periods of postnatal ontogenesis. This will allow us to carry out scientific experimental work on laboratory animals.

Objective of the study. To study anatomico-topographic peculiarities of the stomach of rats and to determine its growth and developmental patterns in the period of early postnatal ontogenesis, by means of functionally diagnostic methods of investigation.

Materials and research methods.

The work was carried out on 96 mongrel rats. The rats were kept in usual conditions of the vivarium, which were obtained from the same nursery. They were divided into 2group- 11 day-old rats (n=22). IIgroup- 16-day-old rats (n=21) Against the background of inhalation general anaesthesia with isoflurane, the rats were decapitated in all animals one by one, the usual sectional removal of the anterior chest and abdominal cavity walls was performed and their contents were photographed. The traditional anatomical dissection was then resorted to, which consisted in the extraction of the stomach from the abdominal cavity.

In the period of early postnatal ontogenesis, morphometric measurements were performed in 11 and 16 day olds using a caliper (in cm).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.The large and small curvature of the stomach was measured. At the level of the small curvature of the stomach two openings were identified - esophageal (at the level of the stomach body) and duodenal (at the level of pyloric sphincter), distances between the openings were measured, and the length of the abdominal part of the esophagus was measured in cm.

Ultrasound examination determined the borders of abdominal cavity of rats in age-matched aspect, which is bordered: from above by rib-arc, 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 to the anteroposterior axes, where the volume of the abdominal cavity in rats is revealed (in cm3).

Two horizontal lines were drawn to reveal topographic-anatomical borders and areas of the abdomen in rats: the upper intercostal line and the lower intercostal line; thus, the rat abdominal wall was divided into three areas: the upper epigastric, the middle mesogastric and the lower hypogastric.

The rat stomach changes its position in these areas during development. Based on the proportion of the stomach located in the abdominal regions, determine the percentage of the rat's stomach to identify the location of the stomach in these regions of the abdominal cavity.

In studying the volume of the stomach (in cm3) of rats in different age groups Archimedes' law of fluid statistics in the stomach cavity was used, water was introduced through the oesophagus with a probe while the second opening - the pyloric sphincter of the stomach was covered with surgical forceps. An expulsive force equal to the weight of the volume of the liquid displaced by the body part immersed in the liquid acts on the liquid.

Results of the study

It is known that the rat's stomach is an expanded part of the digestive tract and for receptacle of food.By 11 and 16 - day-old rats, the stomach is located in the left side of the abdomen at the level of XI and XII thoracic vertebrae, with its long axis directed transversely to the sagittal plane.

The stomach of rats on day 11 of development is often stocking shape 61.5%, hooked shape 30.8% and least horseshoe shape 15.7%. At 16 days of age the stomach shape is more often stocking 33.3%, hook 33.3% and horseshoe 25.0% and less often the shoe shape 8.3%.

Abdominal ultrasound reveals the abdominal boundaries of the rat abdomen. The wall is bounded at the top by the rib arches, at the bottom by the iliac crest, pelvic bone, inguinal ligaments and the upper edge of the pubic joint, the symphysis. The lateral borderline is formed by the vertical lines connecting the ends of the XII ribs to the anterior superior ends of the animal's iliac bone. Volume of abdominal cavity in 11 day old rats averaged 7.19±0.06 cm3 , by 16 day old animals 14.25±0.25 cm3 . As of the 11th day of life, the gastric capacity coefficient averaged 7.69±0.16%, and at the age of 16 days, this coefficient averaged 4.96±0.2%.

To reveal the topographic-anatomical boundaries and abdominal area of the animals, two horizontal lines were drawn: upper - intercostal and lower - intercostal with which the abdominal wall was divided into three floors: upper - epigastric, middle - mesogastric and lower - hypogastric.

In 11-day-old rats, the stomach was located in the upper epigastric region of the abdomen and averaged 1.16±0.01 cm (70% was located in the epigastrium and 30% in the mesogastrium). By day 16 of rat development, the stomach is 1.27±0.001cm3 in the epigastric region of the abdomen and 1.30±0.08cm3 in the middle floor of the mesogastric region (60% located in the epigastrium and 40% of the mesogastrium).

On day 11 and day 16 of rat life, the anterior lower surface of the stomach contacts the diaphragm and the abdominal wall and the covered left lobe of the liver. The posterior upper surface of the organ is located closer to the vertebral column at the level of the 12th thoracic vertebra (in the vicinity of the liver gate) behind the peritoneal space.

According to the location of the stomach in 11 and 16-day-old rats, three sections are distinguished: the bottom - facing the diaphragm, the body - facing the abdominal wall, and the pyloric section facing the liver gate.

The length of the stomach in 11 day-old rats is on the average 1,76±0,07 cm, to 16 day-old development the length of the stomach is on the average 2,57±0,08 cm. At the level of organ fundus, the width of the stomach in 11 day-old rats was on the average 1,03±0,06 cm, at the level of the stomach body - 1,79±0,07 cm, at the level of pyloric organ - 1,66±0,05 cm. By 16 days of life, the width of the stomach at the level of the fundus was 1.53±0.07 cm, at the level of the body of the organ - 2.27±0.11 cm and at the pyloric part of the stomach - 1.96±0.06 cm.

The vertical plane in 11- and 16-day-old rats divides into two parts: transparent and opaque. This is the limiting ridge that runs just below the esophagus around the circumference of the large and small curvature of the stomach. In Fig. 3shows the mucosa of the transparent and opaque part of the stomach of the 11-day-old rat with the limiting ridge.

The vestibule of the stomach - the transparent part is the receptor of food and serves as a receptacle for it. Length of the transparent part in the 11-day-old rat is on the average 1.54±1.73 cm. By 16 days of life, the length of the stomach is 0.24±0.08 cm. On the 16th day of life, the opaque part is located somewhat to the right in the abdominal cavity in it a pronounced pyloric sphincter, which controls the promotion of food from the body of the stomach towards the duodenum.

By 11 and 16 days of age, the large curvature of the stomach of rats is located caudally, and is mobile, facing the anterior abdominal wall.And it is more mobile relative to the small curvature.

On the 11th day of life of rats the length of the greater curvature averaged 3.52±0.14 cm, by the age of 16 days the length of the greater curvature averaged 5.13±0.17 cm. Small curvature of stomach in these age groups is located proximally under the liver and from above it faces the vertebral column. The length of the small curvature in 11 rats averaged 0.53±0.03 cm. On the 16th day of development, the length of the small curvature averaged 0.75±0.03 cm.

The abdominal part of the esophagus of 11- and 16-day-old rats, which is located in the middle of the small curvature of the stomach, forms the entrance to the stomach, here the mucosa of the esophagus continues directly to the mucosa of the stomach. By 11 days of age, the mucous membrane of the esophagus curving in the form of a scallop does not completely surround the esophageal opening, passing into the mucous membrane of the stomach, forming a low esophageal-gastric flap. By 16 days of age, the mucous membrane curves completely around the esophageal orifice forming a lobule-shaped flap of the stomach. Fig. 5 shows the oesophageal-ventricular flap in the form of a petal in 16-day-old rats. By day 11, the abdominal length of the rat's oesophagus averages 0.22±0.01cm. By 16 days of age it is 0.26±0.001cm. Along the lesser curvature on the right, at some distance from the oesophagus, there is a 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 interval between two stomach orifices in 11-day-old rats averaged 0.36±0.02 cm. On the 16th day of life, this distance averaged 0.50±0.02 cm. From Fig. 6 shows that in the small curvature there is a ventral part of the oesophagus and the initial part of the duodenum where the pyloric sphincter of the stomach of 16-day-old rats is located. By 11 day old age, the capacity of the stomach was on the average 0,55±0,01 cm3, of them in the transparent part of the organ was on the average 0,42±0,01 cm3, in the opaque part - 0,132±0,003 cm3. To 16 day old the capacity of the stomach is on the average 0,70±0,02 cm3, in the transparent part - 0,55±0,01 cm3, non-transparent part - 0,15±0,01 cm3. When food enters the stomach, it increases in size due to an enlargement of the large curvature of the stomach, with the stomach in 11 and 16 day-old rats hanging over the oesophagus and the pyloric part of the duodenum, which is in the middle of the small curvature. At the same time, the floor of the stomach when the organ is empty is somewhat cranial under the diaphragm, and when the stomach is full, the floor of the organ falls slightly downwards, due to an increase in the large curvature, which is turned downwards and the stomach hangs downwards, taking the form of an anchor. Thus, it is found that during the period of early postnatal ontogenesis, the shape of the stomach of rats is as follows: stocking, hook, horseshoe and shoe. At the age of 11 and 16 days postnatal ontogenesis, the shape of the stomach most takes the form of a hook. In our opinion, the great diversity of stomach shapes in rats in early postnatal ontogenesis is related to omnivorousness and dietary diversity. The greatest rate of increase in length and greater curvature of the stomach of rats was found on day 16 of life, by 31.4% in relation to 11 days of age. The greatest rate of increase in gastric width in rats is noted at the level of the fundus and pyloric part of the stomach by 6 days of age by 37.0% in relation to the newborn.

In the period of early postnatal ontogenesis (age-appropriate), abdominal ultrasound examination revealed abdominal boundaries of the rat abdomen. The wall at the top is bounded by the rib arches, at the bottom by the iliac crests, pelvic bone, inguinal ligaments and the upper edge of the pubic joint, the symphysis. The lateral border runs along the vertical lines connecting the ends of the XII ribs to the anterior superior ends of the animal iliac bone.

Conclusions:

1.The shape of the stomach at 11 and 16 days of age has the greatest stocking shape. By 11 and 16 days of age the shape of the stomach is the least horseshoe-shaped.

2.To determine the topographo-anatomical boundaries and areas of the stomach in rats, two horizontal lines were drawn: upper intercostal and lower intercostal, so the rat abdominal wall was divided into three areas: upper epigastric, middle mesogastric and lower hypogastric, to show the stomach location in these areas of the abdomen.

3 The rat stomach is divided into three sections: the floor of the stomach facing the diaphragm to the right, the body of the stomach facing in the middle of the abdominal wall, and the pyloric region of the stomach facing behind the peritoneal space in proximity to the liver gate.

4. By 11 days of age, the mucous membrane of the oesophagus curving in the form of a scallop does not completely surround the oesophageal opening, passing into the gastric mucosa, forming a not high oesophageal-gastric flap. On the 16th day of development, the mucous membrane curves completely around the oesophageal foramen forming a petal-shaped esophagogastric flap

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