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Microanatomical Structure of the Stomach Wall of Rats in Early Postnatal Ontogenesis

N.L. Bobomurodov
Bukhara State Medical Institute named after Abu Ali ibn Sino

Annotation: The need for a morphological study of the structure of the stomach wall is dictated by the fact that the end of the 20th century is characterized by a sharp increase in the number of diseases of the stomach. In the USA in 1997, 140,000 patients with gastric bleeding L. Laine (2002) were hospitalized. In Russia in 1999, 64,000 patients with gastrointestinal bleeding were hospitalized, which is almost 2.2 times more than in 1990 (statistical materials of the Ministry of Health. RF. 2000).

Keywords:

Introduction. The need for a morphological study of the structure of the stomach wall is dictated by the fact that the end of the 20th century is characterized by a sharp increase in the number of diseases of the stomach. In the USA in 1997, 140,000 patients with gastric bleeding L. Laine (2002) were hospitalized. In Russia in 1999, 64,000 patients with gastrointestinal bleeding were hospitalized, which is almost 2.2 times more than in 1990 (statistical materials of the Ministry of Health. RF. 2000). All this, according to the researchers, is a consequence of an increase in the severity of the course of peptic ulcer of the stomach and 12 duodenal ulcer (K.V. Puchkov et al., 2000; G.B. Cadiere, 1999). Changes in the symptoms and clinic of stomach diseases lead to changes in the ecological and climatogeographic conditions of the environment (V.A. Karpin et al., 2001; B.A. Abdullaev, 2003).

The aim of the research. From the study of the age features of microanatomical structure of the wall of the stomach of the rat

Materials and methods. The study was conducted on 150 rats, a newborn, 6, 11, 16, 36, 41, 46 and 52 days of age. All animals were kept in the same vivarium conditions.

Mothers (female rats) of both control and experimental groups received the same daily diet. In order to determine which period in early postnatal ontogenesis is the most sensitive to the action of harmful environmental factors, the following series of experiments were put: 1) from 1-6 days of life; 2) from 6 to 11 days of development; 3) from 11 to 16 days; 4) from 16 to 22 days. Slaughter was performed 30 days after the end of each series of the experiment.

Results of the study. In the mucous membrane of the esophageal region of a newborn rat, a multilayered keratinizing epithelium is detected. Three rows of cells are identified in it. The basal row is formed by small rounded or oval-shaped cells that fit tightly together. In the middle and proximal rows there are larger oval cells. Unlike the cells of the basal series, the nuclei in them are found closer to the periphery. Epithelial cells in all rows lie in the longitudinal direction. The epithelial cover the esophageal region is covered with a cuticle.

In the mucous membrane of the intestinal part of the stomach, glands are detected, the mouths of which are covered with a single-layered prismatic epithelium. The height of the epithelium decreases in the direction from the place of entry into the stomach - the esophagus to the pyloric canal by 1.5 times (Table 2) at 6 days of age, the height of the epithelium prevails in the esophageal region - by 1.8 times.

By 11 days of age, the height of the epithelial cover increases, it is more in the esophageal region - 2.1 times. At 16 days of age, the height of the epithelium of the mucous membrane continues to increase, and prevails in the esophageal region - 2.3 times. The glandular apparatus of the gastric mucosa of the rat is represented by simple tubular unbranched glands. In newborn rats, structurally formed glands are detected on a small curvature. By 6 days of age, the glands of the rat's stomach are fully formed. In the region of the large curvature of the organ, the glandular apparatus has a larger area of location, compared to the glands of small curvature. On the small curvature of the stomach, the glands occupy the area from the place of confluence of the esophagus into the stomach to the pyloric canal. In the pyloric canal, glandular structures are located on both sides of it, starting from the entrance to the opening of the duodenum. Glandular structures of the large

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curvature and pyloric canal, and glands of small curvature of the stomach lie on their own plate of the mucous membrane and are separated from each other by thin layers of connective tissue.

Table 2. The thickness of the membranes of the stomach wall of newborn rats of the control group.

$\overline{X} \pm \overline{x} \div$

Structural components of the wall	Esophageal Department	Intestinal department
Thickness of the stomach wall	81,2-223,3 144,1±10,9±	263,0-527,8 371,4±20,3±
Muscular membrane	32,8-82,0 55,7±3,7±	65,6-180,4 113,1±8,8±
Circular muscle layer	8,2-32,8 22,1±1,8±	24,6-41 29,5±1±,2
Longitudinal muscular layer	24,6-49,2 31,9±1,8±	24,6-164 69,7±10,7±
Mucosa	24,6-41,0 30,3±1,2±	106,6-237,8 154,9±10,1±
Submucosal base	8,2-24,6 16,4±1,2±	12,3-24,6 14,7±1,2±
Epithelial integument	12,3-24,6 17,2±0,9±	8,2-16,4 11,4±0,6±

The height of the rodpits on the large curvature of the organ is from 101.5 to 162.4 μm. On the small curvature, the height of the glands is greater from 203 to 263.9 μm. In the pyloric canal, the depthof the rod pits ranges from 60.9 to 121.8 μm. At 6 days of age, the height of the glands is at a large curvature from 142.1 to 203.0 μm, at a small curvature from 243.6 to 365.4 μm, in the pyloric canal, it ranges from 121.8 to 223.3 μm. In rats of 11 days of age, the height of the glands at large curvature reaches from 304.5 to 385.7 μm, at low curvature from 304.5 to 426.3 μm, in the pyloric canal from 162.4 to 304.5 μm. At 16 days of age, the height of the glands at large curvature is from 466.6 to 588.7 μm, at low curvature from 324.8 to 466.9 μm, in the pyloric canal from 203.0 to 385.7 μm. In newborn pups, the diameterof rod pits on the large curvature and in the pyloric canal is from 16 to 28.7 μm. The diameter of the bottom of the glands at low curvature is from 16.4 to 24.6 μm. At 6 days of age, the diameter of the glands at large curvature is from 16.4 to 28.7 μm, at low curvature from 20.5 to 24.6 μm, in the pyloric channel from 16.4 to 28.7 μm. By 11 days of age, the diameter of the glands at large curvature and small curvature, and in the pyloric canal ranges from 20.5 to 28.7 μm. At 16 days of age, the diameter of the glands at large curvature reaches from 24.6 to 32.8 μm, at low curvature from 24.6 to 28.7 μm, in the pyloric canal from 20.5 to 28.7 μm. The width of the lumen of the glandular fossa of the large curvature of the organ varies from 12.3-16.4 μm, in the pyloric canal from 8.2 to 12.3 μm. On the small curvature, the width of the isthmus of the glands ranges from 4.1 to 8.2 μm. During the early postnatal ontogenesis, there was no significant difference in the width of the lumen of the isthmus of the glands. The density of the glandular fossa on the great curvature and in the pyloric canal is from 6 to 9. On a small curvature, the density of the location is from 7 to 9. The structure of the glands of the stomach is represented from the main part (bottom and body) and the excretory part (isthmus and neck). The bottom and body of the glands are built from the main and parietal cells. The isthmus and neck of the glands are formed by parietal and mucous cells. The main cells are rounded in shape with a centrally located nucleus. Parietal cells are larger in size than the main ones. These cells have 1-2 nuclei in the center, or one nucleus at the periphery. Mucous cells are elongated, oval in shape, in the center lies a flattened or triangular-shaped nucleus. The study of the quantitative composition of glandular cells revealed that in newborns in the region of thegelatinous fossa of large curvature, the content of the main cells is 14.1±0.4, parietal - 19.3±0.6. In the glands of small curvature in the region of the bottom and body, the number of main cells is - 21.0±0.5, parietal - 19.1±0.5. In the fossa of the pyloric canal in the region, the content of the main cells is - 13.8±0.6, parietal - 11.7±0.5. In the region of the glands±±±±±, the fishing rod The number of parietal cells on a large curvature is 17.8±0.5, mucous membranes - 11.2±0.6. On the small curvature in the isthmus and neck of the glands, the content of parietal cells is - 20.3±0.5, mucous membranes - 10.2±0.3. In the pyloric canal ±±±±in the region of the fossa, the number of parietal cells is equal to - 10.3±0.7, mucous membranes - 7.9±0.3. At 6 days of age in the region

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of the bottom and body of the glands of large curvature, the number of main cells is 17.1±0.5±±± , in the glands on the small curvature of the main cells - 22.1±0.5, parietal - 21.1±0.7, in the pyloric canal in the glands of the main cells 18.3±0.7, parietal - 13.2±0.5. On the large curvature in the isthmus and neck, the content of parietal cells is - 19.2±0.7, mucous membranes - 14.2±0.6, on the small curvature of parietal cells - 22.1±0.4, mucous membranes - 13.5±0.4. In the pyloric canal of parietal cells - 12.4±0.6, mucous membranes - 10.5±0.4. In 11 day-old rats in the region of the body and the bottom of the glands of large curvature, the number of main cells is 19.2±0.4, on the small curvature in the glands in the region of the bottom and body, the content of the main cells is 23.1±0.4, in the glands of the pyloric canal in the region of the bottom and body of the main cells - 21.4±0.7, parietal - 15.1±0.6. In the region of the isthmus and neck of the glands of great curvature, the content of parietal cells is 21.1±0.5, mucous membranes - 16.7±0.5, in the glands of low curvature of parietal - 22.6±0.4, mucous membranes - 16.7±0.5, in the glands of the pyloric parietal canal - 14.7±0.6, mucous membranes - 12.6±0.4. At 16 days of age, in the region of the bottom and body of the glands of large curvature, the content of the main cells is 23.3±0.5, in the glands of small curvature in the region of the bottom and body of the main cells - 25.0±0.5, parietal - 22.2±0.6, in the glands of the pyloric canal of the main cells - 25.6±0.9, parietal - 18.3±0.7. In the region of the isthmus and the neck of the glands of great curvature, the number of parietal cells is - 21.9±0.7, mucous membranes - 18.5±0.4, in the region of low curvature of parietal - 23.1±0.5, mucous membranes - 20.4±0.7, in the glands of the pyloric parietal canal - 16.1±0.5, mucous membranes - 13.8±0.3.++++++++++++++++++++++++++++++

The stomach mucosa's own plate is formed by fibrous connective tissue structures. Bundles of collagen fibers in their own plate have a different direction in the esophageal region. Bundles of collagen fibers between the folds of the mucosa are directed longitudinally. In the folds of the mucous membrane, the bundles change their orientation and are directed in different directions. In the intestinal part of the stomach, bundles of collagen fibers are located more densely than in the esophageal and oriented longitudinally. Bundles of collagen fibers adjacent to the bottom of the glandular formations change their direction and penetrate between them. Around the vessels, bundles of collagen fibers are oriented circularly. The thickness of the bundles of collagen fibers in the own plate of the mucous membrane decreases, starting from the esophageal region - 16.4 μm to the intestinal - 8.2 μm. Bundles of elastic fibers in the mucous membrane's own plate lie more loosely than bundles of collagen fibers. In the esophageal region, bundles of elastic fibers lie tightly between the folds of the mucous membrane. At the base of the folds of the mucous membrane, bundles of elastic fibers are directed in different directions. In the intestinal section, the bundles of elastic fibers are directed longitudinally, part of the bundles adjacent to the glandular formations changes their direction, and are located between them, separating them from each other. Around the vessels of its own plate, bundles of elastic fibers are located circularly. In its own mucosal plate, the thickness of the bundles of elastic fibers varies from 16.4 μm in the esophageal region to 8.2 μm in the intestinal region. Reticular fibers in their own mucosal plate have different directions. In the esophageal region, the reticular fibers between the folds of the mucous membrane are directed longitudinally. In the folds of the mucous membrane, reticular fibers form reticular structures. In the intestinal region, reticular fibers lie longitudinally, part of the fibers located at the bottom of the glandular formations, change direction and pass between them, separating them from each other.

Under its own plate of the mucous membrane, its muscular plate is detected. It is formed by 1-2 rows of smooth muscle cells.

In the intestinal region, the height of the mucous membrane is 5.1 times greater than in the esophageal region (Table 2). At 6 days of age, the height of the mucous membrane is 3.1 times greater in the intestinal region (Table 3).

Table 3. Thickness ofshells eto the wallstoand stomach of 6 day-old pups of the control group

$\overline{X} \pm \overline{x} \div$

Structural components of the wall	Esophageal department	Intestinal department
Thickness of the stomach wall	142,1-304,5* 209,1±12,5±	294,3-588,7 408,1±22,6±
Muscular membrane	65,6-164 * 95,1±7,5±	49,2-213,2 125,4±12,6±

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Circular muscle layer	16,4-73,8* 42,6±4,4±	24,6-90,2 36,9±5,1±
Longitudinal muscular layer	41,0-98,4 49,2±4,4±	24,6-172,2 77,1±11,3±
Mucosa	41-106,6* 51,7±	139,4-303,4 192,7±12,6±
Submucosal base	16,4-65,6* 38,5±3,7±	12,3-41,0 19,7±2,2±
Epithelial integument	16,4-32,8* 24,6±1,2±	8,2-16,4 13,1±0,6±

* - Reliable difference between ages

By 11 days of age, the height of the mucous membrane continues to increase and it is 2.3 times greater in the intestinal region (Table 4).In 16 day-old rats, the height of the gastric mucosa prevails 2.1 times in the intestinal region (Table 5).

Table 4. Thickness of the membrane of the wall of the stomach of 11 day-old rats of the control group

$\overline{X} \pm \overline{x} \div$

Structural components of the wall	Esophageal department	Intestinal department
Thickness of the stomach wall	182,7-365,4* 284,2±14,1±	324,8-629,3 454,7±23±,4
Muscular membrane	114,8-246,0* 150,8±10,1±	49,2-237,8 140,2±14,5±
Circular muscle layer	24,6-106,6 58,2±6,3±	24,6-123 44,3±7,5±
Longitudinal muscular layer	57,4-155,8* 86,1±7,5±	32,8-188,6 83,6±12,0±
Mucosa	24,6-90,2 61,5±	156,8-257,4 223,8±13,4±
Submucosal base	24,6-90,2 51,7±5,1±	12,3-57,4 23,8±3,4±
Epithelial integument	16,4-41,0 28,7±1,8±	8,2-20,5 13,1±0,9±

* - Reliable difference between ages

Table 5. Thickness of the membranes of the stomach wall of 16 day-old pups of the control group

$\overline{X} \pm \overline{x} \div$

Structural components of the wall	Esophageal department	Intestinal department
Thickness of the stomach wall	233,5-466,9 334,9±17,9±	355,3-690,2 487,2±25,7±
Muscular membrane	131,2-295,2* 207,4±12,6±	65,6-278,8 150,8±16,4±
Circular muscle layer	32,8-139,4 82,0±8,2±	16,4-155,8 54,1±10,7±
Longitudinal muscular layer	65,6-237,8* 118,9±13,2±	32,8-205,0* 91,0±13,2±
Mucosa	90,2-180,4* 117,3±6,9±	188,6-385,4* 255,8±15,1±
Submucosal base	24,6-106,6 62,3±6,3±	12,3-73,8 25,4±4,7±

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Epithelial integument	24,6-49,2 32,8±1,8±	8,2-20,5 14,0±0,9±

* - Reliable difference between ages.

The submucosal base of the stomach is formed by bundles of loose connective tissue. Bundles of collagen fibers in the esophageal region are located loosely and oriented in different directions. In the intestinal section, bundles of collagen fibers are directed longitudinally and have a greater density of location than in the esophageal region. Around the vessels of the submucosal base, bundles of collagen fibers lie circularly. The thickness of the bundles of collagen fibers in the submucosal base ranges from 8.2 μm to 24.6 μm. Bundles of elastic fibers in a submucosal base have a lower distribution density than bundles of collagen fibers. In the esophageal region, the bundles of elastic fibers are located in different directions. In the folds of the mucous membrane, bundles of elastic fibers form a network-like structure. In the intestinal section, bundles of elastic fibers are directed longitudinally and lie more densely than in the esophageal region. Around the vessels, bundles of elastic fibers are oriented circularly. The thickness of the bundles of elastic fibers in the submucosal base varies from 16.4 μm in the esophageal region to 8.2 μm in the intestinal region.

Reticular fibers in the submucosal base of the esophageal region form a finely looped network. In the intestinal region, the reticular fibers are directed longitudinally. Around the vessels of the submucosal base, reticular fibers lie circularly. The submucosal base in the stomach has a slight difference in thickness. By 6 days of age, the thickness of the submucosal base of the stomach is 2 times greater in the esophageal region. In 11 day-old rats, the thickness of the submucosal base of the stomach prevails 2.2 times in the esophageal region. By 16 days of age, the thickness of the submucosal base of the stomach is also more pronounced in the esophageal region by 2.5 times.

The muscular membrane of the stomach is formed by two layers of muscle. The inner layer is represented by longitudinal bundles of myocytes. The outer layer consists of circularly directed muscle fibers. The inner longitudinal layer in the esophageal region is formed by bundles of myocytes of an elongated oval shape, their longitudinal size is larger than the transverse one. In the intestinal section, the bundles of myocytes have an oval shape. The thickness of the longitudinal muscular layer is 2 times greater in the intestinal region than in the esophageal (Table 2). At 6 days of age, the thickness of the longitudinal layer of the muscular membrane of the stomach is 1.6 times greater in the intestinal region than in the esophageal region. At 11 days of age, the longitudinal muscular layer has a slight difference in thickness along the stomach wall. By day 16atthe age of 16, the thickness of the longitudinal muscle layer is more than 1.3 times in the esophageal part of the stomach.

The fibers in the circular muscular layer fit snugly together throughout the stomach wall. The thickness of the circular muscular layer is more than 1.3 times in the intestinalregion than in the esophageal region (Table 2). By the age of 6, the thickness of the circular muscular layerof the stomach is greater by 1.2 times in the esophageal region. By the age of 11, the thickness of the circular muscular layer is also 1.3 times greater in the esophageal part of the organ. In 16 day-old rats, the thickness of the circular muscular layer is greater by 1.5 times in the esophageal region. stomach. Bundles of myocytes of the muscular membrane are separated from each other by layers of connective tissue. Bundles of collagen fibers in the longitudinal muscle layer separate bundles of myocytes from each other, surroundingand repeating their shape. In some parts of the esophageal and muscular parts, bundles of collagen fibers continue into the submucosal base and the connective tissue layer between the circular and longitudinal layers of the muscular membrane. In the circular muscular layer, bundles of collagen fibers are directed longitudinally. The thickness of the bundles of collagen fibers in the muscular membrane ranges from 4,1 up to 8.2 μm.

In the longitudinal muscular layer, bundles of elastic fibers surround the bundles of myocytes and repeat their shape. In some areas of the esophageal and intestinal regions, bundles of elastic fibers continue into the submucosal base and the connective tissue layer between the longitudinal and circular layers. In the circular muscular layer, bundles of elastic fibers are oriented longitudinally. The thickness of the bundles of elastic fibers in the muscular membrane varies from 4.1 to 8.2 μm.

Reticular fibers in the longitudinal muscular layer form loops around the bundles of myocytes, in the circular muscle layer they are directed longitudinally. In some areas of the esophageal and intestinal regions, reticular fibers continue from the longitudinal muscle layer to the submucosal base and the connective tissue layer between the muscle layers. The thickness of the muscular membrane is 2 times greater in the intestinal

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region compared to the esophageal (Table 2.). By the 6th day of age, the thickness of the muscular membrane of the stomach is greater by 1.3 times in the intestinal region. In 11 day-old rats, the thickness of the muscular membrane of the stomach is 1.1 times greater in the esophageal region, than in the intestinal. In 16 day-old rats in the stomach, the thickness of the muscular membrane is 1.4 times greater in the esophageal part of the stomach.

The outer shell of the organ is serous, it consists of a thin connective tissue layer covered with mesothelium. Bundles of collagen, elastic fibers and reticular fibers in the outer shell are directed longitudinally, and their thickness varies from 4.1 to 8.2 μm. The thickness of the outer shell varies from 8.2 to 16.4 μm.

The vascular system of the stomach of rats is represented by the vessels of the mucous membrane, muscular and outer shell. In the mucous membrane, arterioles, capillaries and venules of the submucosal base are detected. The wall of the arteriole consists of three membranes. The inner shell is formed by rounded endothelial cells located at a slight distance from each other. The middle muscular membrane is represented by one row of smooth muscle cells lying in a circular direction.

Between these membranes lies an internal elastic membrane with a weakly pronounced folding. The outer shell is formed by a loose fibrous tissue. It distinguishes adventitial cells. The wall of the capillaries is represented by an endothelial membrane. Endothelial cells in the capillary wall are rounded in shape and lie at a slight distance from each other. The wall of the venules is also formed by a single endothelial membrane. Endothelial cells in the wall of the venules, unlike capillaries, are larger, oval in shape and are located at a great distance from each other. In the submucosal base of the esophageal and intestinal parts, arterioles lie closer to the muscular membrane. In the esophageal region, most venules are directed longitudinally. In their own plate of the mucous membrane of the intestinal department, single ones are detected. In the own plate of the mucous membrane of the intestinal department, single capillaries lying at the bottom of the glands. The study of the diameter of the lumen and the thickness of the wall of the vessels of the mucous membrane showed that in the arterioles and capillaries of the intestinal region, the lumen is larger. In the esophageal region, the diameter and thickness of the wall in the venules is larger (Table 6).

The vessels of the muscular and external membranes are represented by arterioles, capillaries and venules, they lie in connective tissue layers. The structure of the wall of the arteriole, capillary and venule is the same as in the vessels of the mucous membrane. Comparison of the vessels of the membrane of the stomach wall revealed that in the arterioles of the submucosal base the diameter of the lumen is slightly larger (Table 6). In the process of breastfeeding, there is a slight difference in the morphometric characteristics of the vessels of the organ wall, by 36 days of age there is a slight increase in the thickness of the vessel wall. In the wall of the stomach, lymphoid formations are detected. In the submucosal base of the esophageal region, they are represented by a 1-row chain of lymphocytes continuing from the esophagus. In the submucosal base of the intestinal department , 2 row chains of lymphocytes are found throughout its entire length, lymphoid formations lie closer to the muscular membrane. Around the vessels of the submucosal base, lymphoid formations are detected in the form of a 1-2 row chain of lymphocytes. During the lactation period, the formation of lymphoid formations is characterized by an increase in their quantitative composition.

The thickness of the stomach wall is 2.5 times greater in the intestinal region than in the esophageal region (Table 2). By 6 days of age, the thickness of the stomach wall is 2 times predominant in the intestinal region, in 11 and 16 day-old rats it is 1.6 times more in the intestinal region.

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