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MORPHOGENESIS OF THE HUMAN GASTROESOPHAGEAL SEGMENT

Abstract. *The paper has shown that during the second and third trimesters of intrauterine development there is an increase in the external diameter and narrowing of the lumen in the abdominal part of the esophagogastric transition, the formation of the esophagogastric sphincter components, and the diameter of the esophagus ventral part is reliably longer in boys.*

Key words: *embryogenesis, esophagogastric transition, human being.*

Introduction. Anomalies in the digestive system constitute 17.8% and are one of the causes of perinatal mortality [1, 2]. The cases of congenital pathology of the esophageal-gastric segment occur more and more frequently. The esophagogastric sphincter is a barrier between the acid content of the stomach and the alkaline environment of the esophagus. Congenital or acquired dysfunction of the esophagogastric sphincter leads to the development of esophagitis, structural weight loss, laryngospasm and increased cases of sudden death [3,4]. Insufficiency of the esophagogastric sphincter results from the relative or absolute insufficiency of the cardiac obturative mechanism. The relative deficiency of cardia is due to a slight increase in intragastric pressure (intensive reduction of the astral part of the stomach). 9-13% of people with gastroesophageal reflux have relative insufficiency of the cardiac sphincter. 50% of patients with manifestations of gastroesophageal reflux are diagnosed with hernia through the esophageal opening of the diaphragm. With age, the incidence of relative failure of cardia and gastroesophageal reflux disease increases. The importance of data on the early development of man for the medical science in general increases. The ideas about the regularities of the morphogenesis of the esophagogastric transition in the fetal period are rare and unsystematical.

Objective: To study the structure and development of the topography of the esophagogastric transition in fetuses.

Materials: the study was conducted on 38

corpses of fetuses. We used series of histological and topographic - anatomical sections from the museum of the M. H. Turkevych Department of Human Anatomy of Bukovinian State Medical University, Ukraine.

Methods: macroscopic - to determine the relationship between the gastroesophageal segment, the peritoneum and its adjacent organs and structures; corrosion - to study the shape of the transition of the esophagus into the stomach, the characteristics of the His angle; specifications of skeletal features of the esophagogastric segment.

Results and discussion: In the early period of the human ontogenesis the esophagus permeates the diaphragm at an acute angle. The diaphragm, together with diaphragmatic crura, encircles the esophagus tightly. The crura of the diaphragm form a muscular ring around it. The esophagus enters the stomach at the level of the 10th and 11th thoracic vertebrae, the abdominal part of the esophagus is displaced from the median-sagittal axis in the fetuses from 1.0 to 3.0 mm.

At the beginning of the fetal period of human ontogeny intensive processes take place in the esophagus wall to create an obturative mechanism of the esophagogastric transition. Epithelium of the esophagus is stratified, non-keratinizing, some elements of desquamated epithelium can be found in the lumen which are considered to be a residue of the epithelial "plug" of the esophagus.

The esophageal opening in relation to the spine

can be found in the fetuses from 4 to 7 months at the level of the eighth - eleventh thoracic vertebrae, and starting with 8 months of the intrauterine growth also at the level of the ninth and tenth thoracic vertebrae.

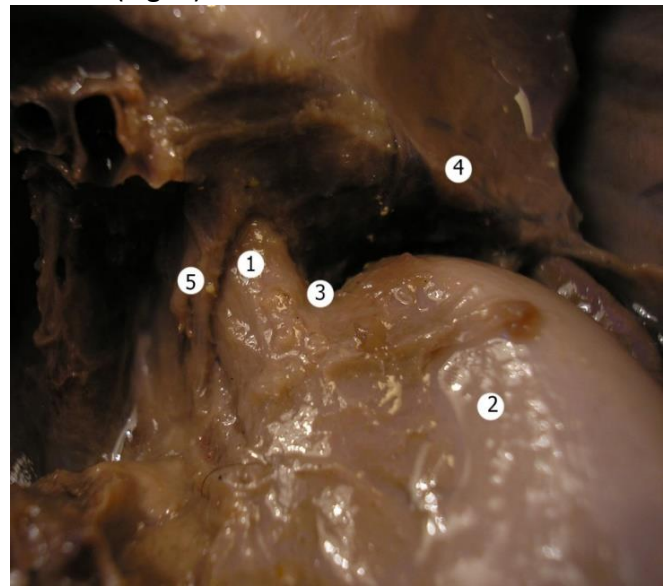
Developing the esophagogastric sphincter begins in the 5th month of intra-uterine growth. During this period, the thickness of the mucosa increases dramatically, the number of folds of the mucous membrane increases to the maximum. At the end of the 5th month, as a result of a well developed mucosa, a cardial fold of the mucous membrane is formed in the region of the cardiac part of the stomach (Fig. 1).



Fig. 1. Horizontal section of the supradiaphragmatic part of the esophagus in a fetus with 190,0 mm of CRL. Stained with hematoxylin and eosin. Slide mount ob. x2, oc. x8: 1 – esophageal lumen; 2 – the fold in the abdominal section of the esophagus; 3 – mucous membrane; 4 – submucous layer; 5 – circular muscle fibers.

At the beginning of the fetal period the diameter of the esophagus at the level of the esophageal opening of the diaphragm (3.60 ± 0.30 mm) is longer than that of its supradiaphragmatic segment (2.85 ± 0.30 mm). In 8-month fetuses the diameters of the esophagus over the diaphragm (4.50 ± 0.14 mm) and at the level of the esophageal opening of the diaphragm (4.45 ± 0.13 mm) are almost identical, whereas in 10-month fetuses the diameter of the esophagus over the diaphragm ($5,60 \pm 0.10$ mm) is longer than that at the level of the esophageal opening of the diaphragm ($5,10 \pm 0,10$ mm), which is indicative of a diaphragmatic narrowing of the esophagus.

The length of the abdominal part of the esophagus in fetuses is variable. Between the 4th and the 6th month the length of the abdominal part of the esophagus increases. Between the 6th and the 8th months of the intrauterine growth there is an insignificant increase in the diameter of the abdominal part of the esophagus (from 4.50 to 4.80 mm) while during the 9th and the 10th months of the perinatal growth the diameter of the abdominal part of the esophagus is the longest. Reduction in the length of the abdominal part of the esophagus continues until the period of birth (Fig. 2).



Organs of the abdominal cavity in a fetus with 200 mm of CRL (the liver had been removed). macropreparation. magn. x4,0: 1 – abdominal segment of the esophagus; 2 – stomach; 3 – angle of His; 4 – diaphragm; 5 – diaphragmatic crura.

Morphologically, diaphragmatic narrowing of the esophagus is only observed in the 8th month of the intrauterine growth, and serves as an additional component of the esophagogastric sphincter. The diameter of the esophagus at the level of the esophageal opening of the diaphragm is almost the same as that of the esophagus over the diaphragm.

Between the 4th and the 6th months of the intrauterine development the horn-shaped stomach is more often observed, it looks like a hook and a sand glass more rarely. Between the 6th and the 10th months we observe the equal number of cases of the horn-shaped stomach and of that looking like a hook.

The angle of His in fetuses aged 4 months is $58.0 \pm 2.70^\circ$, it increases to $71.40 \pm 2.70^\circ$ by the

end of the fetal period. In three cases (fetuses of 251.0 mm, 370.0 mm and 430.0 mm of crown-rump length (CRL)), the right angle of His was observed, in one case (fetus 440.0 mm TDD) the angle was obtuse (115 °).

Blood supply of the abdominal part of the esophagus is carried out by branches of the left gastric artery, the number of which varies from one to four. We also observed additional arteries supplying the abdominal part of the esophagus: the left lower diaphragmatic and upper left adrenal arteries. At the level of the esophageal opening the esophagus is supplied with blood by the branches of the diaphragmatic arteries and the ascending branch of the left gastric artery. With a decrease in blood supply from these arteries, this, in turn, leads to an increase in the extra arteries feeding the abdominal part of the esophagus - the splenic artery and the left hepatic one, which agrees with the statement of A.S. Svintsitsky et al. (7).

Therefore, it can be argued about high individual variability of the components of the esophageal-gastric transition. The allocation of the components clear arrangement in the sphincter of the esophageal-gastric transition is rather relative, as they can vary in the process of growth.

Conclusions. 1) The length of the abdominal part of the esophagus increases by $2.25 + 0.53$ mm - in fetuses in the 4th month and by $2.86 + 0.31$ mm - in the 6th month; Beginning with the 7th month, the length of the esophagus decreases and in newborns the decrease is by $1.5 + 0.15$. The angle of the His value increases during the fetal period by 0.4 times and is $80.47 + 2.83$.

2) In 4-month-old fetuses the skeletotopic projection of the stomach cardiac opening varies within the 9th thoracic vertebra and the 11th one.

Perspectives for further research. It is planned to investigate the features of the esophagogastric

transition in newborns.

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