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DEVELOPMENT OF THE STRUCTURE AND ESTABLISHMENT OF THE TOPOGRAPHY OF THE OVARIES IN THE PERINATAL PERIOD OF ONTOGENESIS

***D. Proniaiev*[1], *M. Yasinskyi*[1], *V. Penteskul*[1], *M. Kavun*[2], *N. Yemelianenko*[1]**

Bukovinian State Medical University[1]
(Chernivtsi, Ukraine)
Kharkiv International Medical University[2]
(Kharkiv, Ukraine)

Abstract.

Although clinicians have historically focused their attention on the fetal heart, brain, kidneys, and skeletal system, recent studies increasingly emphasize the importance of evaluating the gonads for the early diagnosis of congenital anomalies. In the present study, the patterns of morphogenesis and the formation of syntopic relationships of the ovaries during the perinatal period of human ontogenesis are analyzed.

Objective: *to determine the chronological sequence of development and the formation of the topographic and anatomical relationships of the ovaries during the perinatal period of human ontogenesis.*

Materials and methods. *The study was conducted on 35 specimens of human fetal cadavers obtained from the museum of the Department of Anatomy, Clinical Anatomy, and Operative Surgery of Bukovinian State Medical University. Each group was divided into seven subgroups corresponding to the 10 months of the fetal period of development (from the 4th to the 10th month). The morphological study was carried out using conventional and fine dissection techniques, preparation of topographical-anatomical sections, and three-dimensional computer reconstruction of the internal female genital organs for each month of the perinatal period. During the study, the authors adhered to all relevant ethical standards (Bioethics Commission Protocol of BSMU No. 6 dated 20.12.2024). The obtained results were statistically analyzed using descriptive statistical methods, specifically: measurement of central tendency indicators (mean), dispersion indicators (standard error of the mean), and visualization of main trends using graphs. For comparison of two independent groups, the non-parametric Mann-Whitney U test was applied, as the data did not follow a normal distribution. The study was conducted as part of the comprehensive research project of the Department of Human Anatomy named after M. H. Turkevych at Bukovinian State Medical University: «Morpho-functional features of the development of organs and systems within topographical-anatomical regions in human ontogenesis», State Registration No.: 0125U002137 (01.01.2025-31.12.2029).*

Results. *A number of regularities in ovarian development during the perinatal period were established; topographic and morphological changes of ovaries were identified. During development, the position of ovaries changes from an ascending to a horizontal orientation through an intermediate location in the rectouterine pouch, whereas the shape of these organs transforms from an elongated triangular to an elongated oval form, with the gradual disappearance of their segmental structure.*

Periods of accelerated and slowed growth of the morphometric parameters of the ovaries were also identified. The most intensive increase in their length occurs between the 4th and 5th and between the 8th and 9th months of intrauterine development. Ovarian thickness grows most actively between the 8th and 9th months, whereas the width of the organs demonstrates the most pronounced increase between the 4th and 5th and between the 9th and 10th months of development.

Conclusions. *1. Periods of intensive increase in ovarian morphometric parameters were established – the 5th and 6th months and the 9th and 10th months. 2. Asynchronous descent of the right and left uterine tubes into the pelvic cavity was revealed, which coincides with the displacement of the ovaries resulting from their close syntopic relationships. 3. Intensive filling of the intestine with meconium, together with an increase in uterine thickness and ovarian growth, contributes to their displacement into the pelvic cavity and from the rectouterine pouch. 4. In fetuses aged 4-6 months, the ovaries have the shape of a flattened elongated triangular pyramid, with a thickness ranging from 0.96 ± 0.05 mm at the 4th month to 2.00 ± 0.42 mm at the 6th month. At 7-8 months of intrauterine development, the ovaries acquire an elongated rounded shape, with a thickness ranging from 2.02 ± 0.43 mm at the 7th month to 4.08 ± 0.33 mm at the 8th month. 5. Fetuses aged 4-7 months are characterized by an ascending position of the ovaries, in which the right and left ovaries reach the cecum and descending colon, respectively. In fetuses aged 8-10 months, the ovaries predominantly occupy a descending position. The upward displacement of the ovaries is accompanied by a relative slowing of the growth of their morphometric parameters: length, width, and thickness in fetuses from 5 to 8 months do not differ significantly. During the period of accelerated ovarian development, the morphometric parameters of ovarian width in fetuses aged 9 and 10 months differ significantly ($p < 0.001$). Throughout the perinatal period of ontogenesis, the skeletotopy of the ovaries changes from the level of the fifth lumbar vertebra at the beginning of the fetal period to the second sacral vertebra in newborns.*

Keywords: *Morphogenesis; Fetus; Morphometry; Ovaries; Pelvis; Abdominal Cavity; Anatomy; Morphology.*

Introduction

Anatomical research on the prenatal development of the ovaries is of great importance for modern perinatal medicine, as it enables the diagnosis of structural anomalies and supports understanding of the mechanisms of reproductive organ formation, the assessment of intrauterine factors affecting fetal development, the planning of postnatal medical care, and the prevention of potential complications [1-4].

The standardization of research methods and the implementation of advanced technologies in this field can substantially improve the quality of prenatal diagnostics, thereby contributing to better clinical outcomes, whereas morphological studies of the reproductive organs provide

an objective basis for evaluating the results of instrumental diagnostic methods [5-9].

A review of the scientific literature indicates that prenatal examination of the ovaries plays a crucial role in the timely diagnosis of anomalies, planning postpartum follow-up and potential treatment, and the understanding of intrauterine factors' influence on future reproductive health [10-15]

Despite certain methodological and ethical challenges, the inclusion of ovarian assessment in standardized prenatal screening protocols can improve treatment outcomes and prevent gonadal damage in newborns; further research should focus on the standardization of protocols, the evaluation of long-term effects, and the integration of advanced technologies to enhance diagnostic sensitivity and specificity [16-20].

Prenatal fetal examination plays a key role in modern perinatal medicine by enabling the detection of structural and functional anomalies before birth. Among various aspects of such examinations, the study of pelvic organs, particularly the ovaries in female fetuses, is of special importance owing to potential implications for future reproductive health [21-23].

Although clinicians have historically focused on the heart, brain, kidneys, and fetal skeletal system, recent studies increasingly emphasize the importance of gonadal assessment for the early diagnosis of congenital anomalies [24].

Research Aim

To determine the chronological sequence of development and the establishment of the topographic-anatomical relationships of the ovaries throughout the perinatal period of human ontogenesis.

Materials and Methods

The study was conducted on 35 specimens of human fetal cadavers obtained from the museum of the Department of Anatomy, Clinical Anatomy, and Operative Surgery of Bukovinian State Medical University, with each group divided into seven subgroups corresponding to the ten months of the fetal period of development (from the 4th to the 10th month). As a result of morphometric analysis, conventional and fine dissection, preparation of topographic-anatomical sections, and three-dimensional computer reconstruction of the internal female reproductive organs, corresponding variation series were formed for each month of the perinatal period [25]. For these series, distribution assessments were performed, arithmetic means with standard deviations and percentile ranges of values were calculated. The significance of differences between independent quantitative variables was determined using the Mann-Whitney U-test, and Spearman's correlation coefficient was used to analyze correlations among the obtained results.

The study was performed in compliance with the main provisions of the Laws of Ukraine № 2801-XII and № 3447-IV, ICH GCP (1996-2016), the Declaration of Helsinki of the World Medical Association on ethical principles for medical research involving human subjects (1964-2013), European Union Directive 2010/63/EU, the orders of the Ministry of Health of Ukraine № 690 of 23.09.2009, № 944 of 14.12.2009, and the Ministry of Education and Science order № 249 of 01.03.2012 (Bioethics Commission Protocol of Bukovinian State Medical University № 6 of 20.12.2024).

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Results and discussion

In fetuses aged 4-6 months, significant variability in the morphological shape of the ovaries is observed together with a certain asymmetry between the right and left organs, with a triangular, ribbonlike, or irregular shape being most frequently exhibited. During this period, the length of the ovary exceeds its width, while the width exceeds the thickness; based on these morphometric proportions, the apex, base, surfaces, edges, and two ends of the organ are conventionally distinguished.

In all examined cases, the fallopian tubes are located near the apex of the ovary and often lie closely against one of its surfaces, while the edges of the ovary are generally oriented toward the apex. The peritoneum, penetrating the ovarian parenchyma, transitions into its mesentery and further into the broad ligament of the uterus. The considerable length of the ovaries in early-stage fetuses causes surface folding; in these areas, the organ may appear segmented into lobes. The peritoneum remains continuous and does not form additional folds, so such segmentation is considered conditional. With fetal growth, the ovaries gradually acquire a more rounded shape, and individual conditional lobes merge.

In a fetus with a crown-heel length (CHL) of 185.0 mm, the ovaries have an elongated triangular shape without prominent folds and occupy an ascending position, with their bases adjacent to the lateral walls of the rectum. The fallopian tubes run along the ovaries and contact their surfaces: the right tube is positioned dorsally, the left ventrally. The tubal end of the left ovary is adjacent to a loop of the sigmoid colon, whereas the uterine end contacts the uterine fundus; the uterine end of the right ovary is immersed in the recto-uterine pouch.

In a fetus with a CHL of 235.0 mm, the ovaries also have an elongated triangular shape and are bilaterally ascending. The left ovary is slightly curved, with its uterine end lies against the lateral surface of the rectum and the uterine portion of the fallopian tube, whereas the tubal end is located in the intersigmoid recess. The right ovary is elongated, its tubal end reaching the cecum. The fallopian tubes lie along the ventral surfaces of the respective ovaries.

The data indicate a tendency toward a relative decrease in ovarian length accompanied by an increase in width and thickness. During this period, the ovaries may occupy either an ascending or descending position, being partially

immersed in the recto-uterine pouch. In the ascending position, they sometimes reach the cecum or descending colon. Such features, characteristic of fetuses aged 4-7 months, are often combined with a saddle-shaped or grooved uterine form; this topographic-anatomical pattern can be considered a normal variant for this age period.

In a fetus with a CHL of 330.0 mm, both ovaries have a curved shape, with their uterine ends partially immersed in the recto-uterine pouch. Their tubal ends contact intestinal loops, the fallopian tube, the parietal peritoneum, ureters, and iliac vessels. The tubal ends are oriented cranially but do not cross the Jacoby line, indicating that the ovaries remain within the pelvic cavity.

For fetuses in the seventh month of development, a horizontal position of the left ovary with preservation of the ascending position of the right ovary is characteristic. In later stages, the shape of the ovaries changes from elongated triangular to more oval. In the triangular configuration, the surfaces are conventionally distinguished as follows: the surface adjacent to the fallopian tube, the dorsal surface facing the posterior abdominal wall, and the ventral surface directed toward the anterior abdominal wall. By the end of the fetal period, the ovaries predominantly occupy an almost horizontal position within the pelvic cavity.

In a fetus with a CHL of 380.0 mm, the right ovary has an elongated triangular shape and is positioned horizontally along the posterior surface of the right fallopian tube. Its uterine end is immersed in the recto-uterine pouch and dorsally contacts the right ureter; the tubal end and the major part of the organ are adjacent to small intestinal loops, whereas the base of the ovary closely contacts the fallopian tube. The left ovary also has an elongated triangular shape but occupies an ascending position at an angle of approximately 40°. Its uterine end lies against the rectum, and the base contacts the left fallopian tube; the tubal end reaches the left paracolic gutter, and the left ureter passes along its dorsal surface. The ventral surfaces of both ovaries contact small intestinal loops (Figure 1).

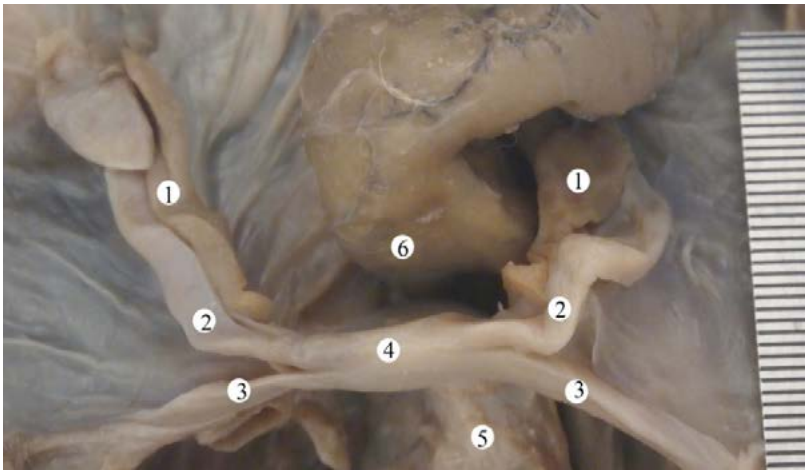

Figure 1. Internal female reproductive organs of a fetus with a CRL of 380.0 mm. Macroscopic specimen. Magnification ×4.5.

1 – ovaries; 2 – fallopian tubes; 3 – round ligaments of the uterus; 4 – uterus; 5 – vagina; 6 – rectum.

In a fetus with a CHL of 360.0 mm, the right ovary has a curved, hook-like shape (Figure 2). Its uterine end is located in the recto-uterine pouch, whereas the tubal end is slightly bent and contacts the fimbriae of the right fallopian tube. The base and dorsal surface of the ovary are adjacent to the iliac vessels and the right ureter, which are covered by the parietal peritoneum of the posterior abdominal wall. The organ exhibits conditional segmentation, with the uterine and tubal lobes separated by a shallow groove. Thus, the division of the ovary into lobes at this age is relative and reflects the age-specific morphological features of the organ.

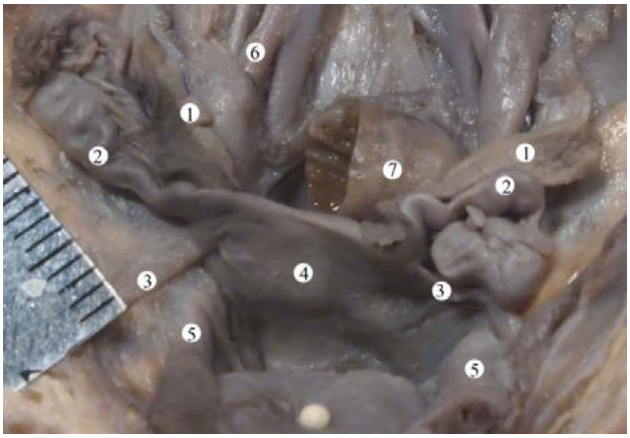

Figure 2. Internal female reproductive organs of a fetus with a CRL of 360.0 mm. Macroscopic specimen. Magnification ×4.

1 – ovaries; 2 – fallopian tubes; 3 – round ligaments of the uterus; 4 – uterus; 5 – rectum; 6 – right ureter; 7 – rectum.

In this case, the left ovary is characterized by a curved tubal end, with approximately two-thirds of its base lying close against the left fallopian tube. The dorsal surface contacts the parietal peritoneum of the posterior abdominal wall, which covers the ureter and iliac vessels, whereas the ventral surface is adjacent to the rectosigmoid segment and the sigmoid colon.

In a fetus with a CHL of 330.0 mm, the right ovary consists of three conventionally distinguished lobes – uterine, intermediate, and tubal – while the left ovary comprises two lobes – uterine and tubal (Figure 3). The right ovary has a triangular shape approaching an oval form and is obliquely positioned within the abdominal cavity, exhibiting anterior, posterior, and lateral surfaces, together with anterior, posterior, and medial edges, the pointed uterine and tubal ends located between them. Loops of the ileum contact the anterior surface of the ovary, whereas the posterior surface is in contact with the ureter, the internal iliac artery, and the internal iliac vein. The uterine end of the ovary lies adjacent to the isthmus of the fallopian tube, and the tubal end is adjacent to the external iliac vessels. The right ovary measures 18.6 mm in length, 6.9 mm in width, and 3.6 mm in thickness, with the ovarian mesentery measuring 10.5 mm in length and 3.3 mm in width.

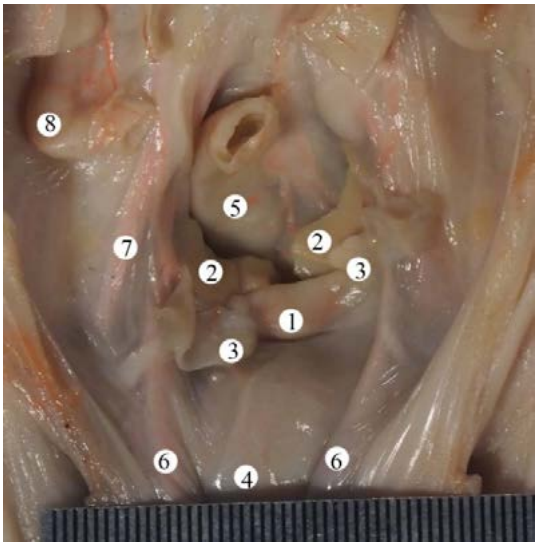

Figure 3. Internal female reproductive organs of a fetus with a CRL of 330.0 mm. Macroscopic specimen. Magnification ×4.

1 – uterus; 2 – ovaries; 3 – fallopian tubes; 4 – urinary bladder; 5 – rectum; 6 – umbilical arteries; 7 – external iliac arteries; 8 – ileum.

In this fetus, the left ovary has an elongated, near-oval shape and is positioned horizontally, its structure including superior, inferior, and anterior surfaces together with superior, inferior, and posterior edges. The uterine end is pointed, whereas the tubal end is rounded. The anterior surface of the ovary is adjacent to the anterior loop of the sigmoid colon, and the posterior edge contacts the ureter. The uterine end contacts the posterior surface of the isthmus of the fallopian tube, and the tubal end lies near the external iliac vessels. The left ovary measures 17.1 mm in length, 6.5 mm in width, and 3.4 mm in thickness, with the ovarian mesentery measuring 9.6 mm in length and 2.4 mm in width.

The proper ligaments of the right and left ovaries measure 3.1 mm and 2.7 mm, respectively, and attach to the left margin of the uterus below the origin of the fallopian tube. The suspensory ligaments of the ovaries, 5.4 mm on the right and 5.6 mm on the left, attach to the iliac fascia and contain ovarian vessels.

In a fetus with a CHL of 320.0 mm (7th month of ID), the left ovary occupies an ascending position, whereas the right ovary has an irregular, curved shape and is located in an intermediate position near the uterine fundus. Both ovaries exhibit a characteristic triangular shape, most clearly seen in the left ovary, which lies along the left fallopian tube and is closely apposed to it along its entire length. Visually, the ovary appears divided into two parts; however, studies indicate that this apparent segmentation results from folds of the outer capsule. At later developmental stages, such segmentation is not observed, suggesting that as the ovarian parenchyma volume increases, the capsule folds gradually flatten, rendering the surface of the organ smoother.

The lateral surface of the left ovary contacts the fallopian tube, and its dorsal surface is adjacent to retroperitoneal structures, including the left ureter. The uterine end is directed ventromedially and follows the fallopian tube to a distance of approximately 5 mm from the uterus. The tubal end is dorsolaterally oriented upward and terminates approximately 8 mm from the lower pole of the left kidney. The ventral surface of the ovary contacts the left lateral surface of the rectum. Thus, the ovary is positioned within a specialized channel, bordered laterally by the left fallopian tube, medially by the rectum, with the floor of the space formed by the left ureter.

The right ovary also has a triangular shape but occupies a descending position. Despite retaining an elongated configuration, its contours exhibit irregular folding. The right fallopian tube is markedly convoluted, with multiple bends. The ovary is closely applied to the tube and follows its contours, forming a «tangled» arrangement composed of the elongated ovary intertwined with the convoluted fallopian tube. The uterine end of the organ is located approximately 4 mm lateral to the uterine fundus, whereas

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the tubal end is about 8 mm from it. Due to the significant tortuosity of the fallopian tube, precise measurement of its length is difficult.

This case can be considered an example of a transitional anatomical variant. The study identifies three main ovary positions during development: ascending, intermediate, and descending. The ascending position is characterized by elongated ovaries extending along the rectum, often in contact with it. The descending position is associated with a convoluted or folded organ, sometimes forming a «tangled» structure, with ovaries located in the space between the uterus and bladder, within the recto-uterine pouch, or on both sides of the uterus beneath the round ligaments. The intermediate position combines features of both, where one ovary is ascending and the other descending. Generally, the ascending position predominates in early fetal development (4-5 months), the intermediate in fetuses aged 6-7 months, and the descending in later stages (8-10 months).

Regarding ovarian morphogenesis, gradual filling of the coelomic capsule by parenchyma occurs, accompanied by transformation from a triangular to a more rounded shape. During this period, a relative «reduction» in ovarian size is observed, meaning that although the length and diameter continue to increase, growth lags behind that of adjacent organs.

In a fetus with a CHL of 470 mm, the ovaries are positioned low, consistent with this stage of intrauterine development (ID). The right ovary has an elongated triangular shape with slight curvature and is located along the right fallopian tube, apposed to its upper edge in an almost horizontal orientation. The uterine end contacts the uterus, while the tubal end is directed toward the right iliac region. Dorsally, the ovary is adjacent to the external and internal iliac arteries, as well as the right ureter.

The left ovary also occupies a low position, slightly caudal to the right. It has a similar elongated triangular shape but is more curved, so that both uterine and tubal ends contact the ventral surface of the rectum. The ventral surfaces of both ovaries are adjacent to the internal and external iliac arteries. In the sagittal plane, the uterine ends lie posterior and lateral to the uterus, contacting its dorsal wall. This configuration is typical for the late fetal period, as both ovaries occupy a low position.

In rare cases, the ovaries may be located not only in the recto-uterine pouch but also in the vesico-uterine pouch (Figure 4). Such localization is consistent with the general concept of the intermediate ovary position.

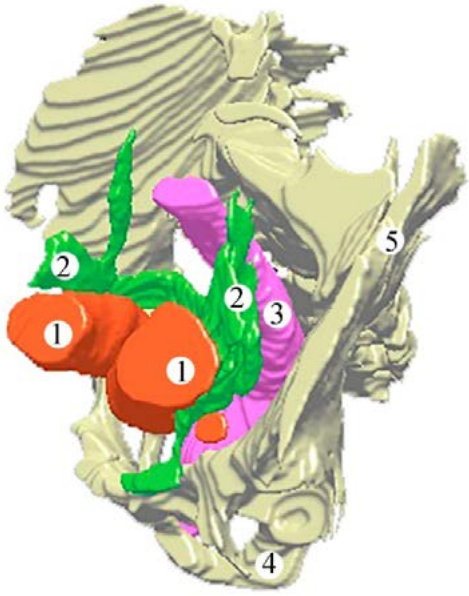

Fig. 4. Computer 3D reconstruction of the pelvic organs of a newborn. Left anterolateral view. Magnification ×1.5.

1 – ovaries; 2 – fallopian tubes; 3 – rectum; 4 – ischial bones; 5 – iliac bone.

The study of the variability in ovarian artery origin showed relative consistency in their anatomical organization. In all cases, these vessels arise from the abdominal aorta and run caudally, crossing the ureters and then the iliac arteries and veins. The site of origin shows minimal variability: in 96.4% of cases, the ovarian arteries originate from the ventral surface of the abdominal aorta, and in 3.6% from the lateral surface. They then enter the suspensory ligament of the ovary. At the ovarian hilum, the ovarian arteries form a branched network, anastomosing with the ovarian branch of the uterine artery.

Analysis of the changes in right ovary length in fetuses aged 4-10 months (Table) showed that in 4-month-old fetuses, this parameter is significantly smaller ($p < 0.05$-0.01) than in subsequent age periods, except for the 6th month ($p > 0.05$). In 5-month-old fetuses, the right ovary length is generally smaller than in 8-10-month fetuses ($p < 0.05$-0.01) but exceeds that of the 6th month ($p < 0.05$). In 6-month-old fetuses, values are significantly lower compared to 5– and 7-10-month-old fetuses ($p < 0.05$-0.01). In 7-month-old fetuses, the parameter does not differ from the 5th and 8th months ($p > 0.05$) but exceeds the 4th and 6th months ($p < 0.05$). At 8 months, right ovary length is significantly smaller than at 9-10 months ($p < 0.05$), while no difference is observed between 9- and 10-month-old fetuses ($p > 0.05$).

A similar analysis of left ovary length revealed a slightly different pattern. In fetuses aged 4-7 months, this parameter

does not differ significantly ($p > 0.05$) but is considerably smaller than in 8-10-month-old fetuses ($p < 0.05$-0.01). Left ovary length in fetuses aged 5-8 months also does not change significantly ($p > 0.05$) but remains smaller than in 9-10-month-old fetuses. No statistically significant differences were found between 8th and 9th months, as well as between 9th and 10th months ($p > 0.05$). Left ovary length at 8 months exceeds values at 4-7 months but is smaller than in 9-10-month-old fetuses, which had the largest sizes among all groups studied ($p < 0.05$-0.01).

Right ovary width in 4-month-old fetuses is significantly smaller than in all older age groups ($p < 0.01$). In 5-8-month-old fetuses, this parameter does not change significantly ($p > 0.05$) but remains smaller than in 9-10-month-old fetuses ($p < 0.05$), with no statistically significant difference between the last two groups ($p > 0.05$).

A similar trend is observed for left ovary width. In 4-month-old fetuses, it is significantly smaller than in all older age groups ($p < 0.01$). In fetuses aged 5-8 months, as well as 6-9 months, no significant changes are observed ($p > 0.05$), but it is significantly smaller than in 9-10-month-old fetuses ($p < 0.05$). No difference is found between 9– and 10-month-old fetuses ($p > 0.05$).

The findings of the present study identified a series of regularities in ovarian development during the perinatal period. Topographic and morphological changes of these organs were observed, with their position changing in the course of development from ascending to horizontal through an intermediate location in the recto-uterine (Douglas) pouch. Concurrently, the shape of the ovaries transforms from elongated triangular to elongated oval, with their segmental structure gradually disappearing.

Table

Morphometric parameters of fetal ovaries

Month	Length (mm)		Width (mm)		Thickness (mm)	
	right	left	right	left	right	left
4	8.36 ± 1.34	8.12 ± 1.43	1.06 ± 0.17	0.96 ± 0.06	2.72 ± 0.50	2.48 ± 040
5	11.36 ± 0.86	10.76 ± 1.87	3.36 ± 0.82	3.16 ± 0.59	1.88 ± 0.11	1.60 ± 0.12
6	9.38 ± 1.28	9.60 ± 1.14	3.50 ± 0.66	3.26 ± 1.14	2.04 ± 0.30	2.00 ± 072
7	11.66 ± 1.28	9.42 ± 1.06	3.32 ± 1.00	3.86 ± 0.69	1.80 ± 0.25	2.02 ± 0.43
8	12.96 ± 1.23	11.84 ± 2.36	4.08 ± 0.64	3.74 ± 0.25	2.28 ± 0.50	1.96 ± 0.37
9	16.24 ± 1.98	15.22 ± 1.87	7.4 ± 1.65	5.00 ± 1.58	4.12 ± 0.27	3.72 ± 0.42
10	16.36 ± 1.88	15.90 ± 1.47	7.60 ± 1.64	6.72 ± 1.62	3.84 ± 0.36	3.34 ± 0.36

Periods of accelerated and decelerated growth of ovarian morphometric parameters were also identified. The most intensive increase in their length occurs between 4-5 and 8-9 months of intrauterine development (ID). Ovary thickness grows most actively between the 8th and 9th months, while the ovarian width demonstrates the most pronounced increase between 4-5 and 9-10 months of development (Figures 6, 7).

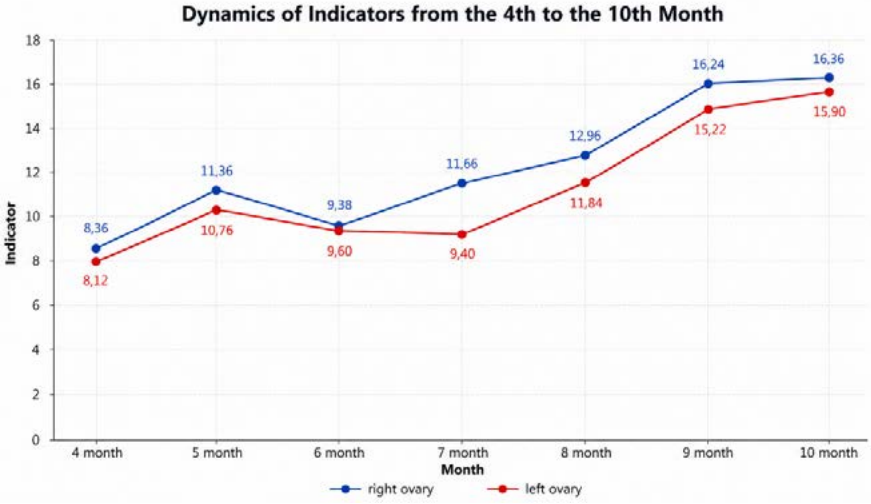

Figure 6. Length of the right ovary in fetuses.

The results of the study indicate that during the perinatal period, the ovaries can occupy both high and low positions, a finding that should not be interpreted as pathological. In all cases of developmental anomalies of the female reproductive system observed in the present study (uterine agenesis and atrophy, bicornuate uterus), a high ovarian position with short suspensory ligaments was noted, indicating impaired prenatal fixation of the organs. Thus, it is evident that ligaments have a significant influence on the topography of the internal female reproductive organs. The broad ligaments of the uterus and the proper ovarian ligaments practically do not alter organ topography and maintain relative constancy, which is likely related to their genetically determined embryonic morphogenesis. At the same time, the morphogenesis of the suspensory ligaments of the ovaries and the round ligaments of the uterus has yet to be fully elucidated, owing to the inherent difficulties of direct observation. The topography of the suspensory ligaments of the ovaries is most influenced by surrounding organs: the cecum, appendix, ascending colon, right ureter, and right

edge of the mesenteric root-mainly affecting the right ovary and/or right suspensory ligament; the sigmoid colon, left edge of the mesenteric root, and left ureter-affecting the left ovary and/or left suspensory ligament. It is well established that even during the embryonic period, ligament formation is accompanied by membranous deposits that form near pathological foci. In regions of the intestine with insufficient vascularization due to mesenteric twists and tension, venous stasis occurs, leading to adhesion of intestinal loops and the formation of additional ligaments. These adhesions are not pathological per se but may be modified under chronic intestinal stasis, colitis, or inflammatory processes from adjacent organs, which can result in a high position of the ovaries. A high position of the organs can be interpreted as a state that reflects or contributes to the formation of congenital developmental defects.

Morphometric analysis showed that the thickness of the right ovary in 4-month-old fetuses is significantly smaller than that in 9-10-month-old fetuses ($p < 0.05$-0.01), but greater than in 5– and 7-month-old fetuses ($p < 0.01$) and does not differ from 6– and 8-month-old fetuses ($p > 0.05$). For 5-8-month-old fetuses, thickness did not change significantly ($p > 0.05$) but was smaller than in 9-10-month-old fetuses, with no statistically significant difference detected between the latter.

Similarly, the thickness of the left ovary in 4-month-old fetuses is significantly smaller than in 9-10-month-old fetuses ($p < 0.01$), greater than in 5-month-old fetuses ($p < 0.05$), and matches the thickness in 6-8-month-old fetuses ($p > 0.05$).

Topographic features of ovarian development in 4-7-month-old fetuses are characterized by an ascending position: the right ovary reaches the cecum, and the left ovary reaches the descending colon, usually in combination with a grooved-shaped uterus. In 8-10-month-old fetuses, the ovaries predominantly occupy a descending position. Upward displacement of the organs is accompanied by a slowdown in the growth of morphometric parameters: length, width, and thickness in 5-8-month-old fetuses do not change significantly ($p > 0.05$-0.01). Throughout periods of accelerated growth (8th and 10th months), however, ovarian width shows significant changes ($p < 0.001$).

Conclusions

1. Periods of intensive increase in ovarian morphometric parameters were identified – the 5th-6th and 9th-10th months, which result from an increase in the size of glandular parenchymal cells without a significant change in their number.

2. Asynchronous descent of the right and left uterine tubes into the pelvic cavity was observed, coinciding with the movement of the ovaries through tight syntopic ligaments.

3. Intense filling of the intestine with meconium, combined with an increase in uterine thickness and ovarian growth, facilitates their displacement into the pelvic cavity and from the recto-uterine pouch.

4. In fetuses aged 4-6 months, the ovaries have the shape of a flattened elongated triangular pyramid, with a thickness ranging from 0.96 ± 0.05 mm at the 4th month to 2.00 ± 0.42 mm at the 6th month. At 7-8 months of intrauterine development, the ovaries acquire an elongated rounded shape, with a thickness ranging from 2.02 ± 0.43 mm at the 7th month to 4.08 ± 0.33 mm at the 8th month.

5. Fetuses aged 4-7 months are characterized by an ascending position of the ovaries, in which the right and left ovaries reach the cecum and descending colon, respectively. In fetuses aged 8-10 months, the ovaries predominantly occupy a descending position. The upward displacement of the ovaries is accompanied by a relative slowing of the growth of their morphometric parameters: length, width, and thickness in fetuses from 5 to 8 months do not differ significantly. During the period of accelerated ovarian development, the morphometric parameters of ovarian width in fetuses aged 9 and 10 months differ significantly ($p < 0.001$). Throughout the perinatal period of ontogenesis, the skeletotopy of the ovaries changes from the level of the fifth lumbar vertebra at the beginning of the fetal period to the second sacral vertebra in newborns.

Prospects for further research. Future research should be directed toward the standardization of anatomical protocols for the assessment of prenatal ovarian development, as well as the refinement of imaging techniques, including three-dimensional reconstruction and the application of artificial intelligence to image analysis. Longterm effects of prenatal ovarian anomalies on reproductive health in adulthood represent an important area for further investigation.

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РОЗВИТОК БУДОВИ І СТАНОВЛЕННЯ ТОПОГРАФІЇ ЯЄЧНИКІВ У ПЕРИНАТАЛЬНОМУ ПЕРІОДІ ОНТОГЕНЕЗУ

***Д. В. Проняєв*[1], *М. М. Ясінський*[1], *В. І. Пентескул*[1], *М. П. Кавун*[2], *Н. Р. Ємєльяненко*[1]**

Буковинський державний медичний університет[1]
(м. Чернівці, Україна),
ПВНЗ Харківський міжнародний медичний університет[2]
(м. Харків, Україна)

Резюме.

Незважаючи на те, що увага клініцистів історично була зосереджена на лікуванні хвороб серця, головного мозку, нирок та скелеті плода, останні дослідження все частіше підкреслюють важливість оцінювання гонад для ранньої діагностики природжених аномалій. У даному науковому дослідженні ми проаналізували закономірності морфогенезу та становлення синтопічних взаємовідношень та топографії яєчників упродовж перинатального періоду онтогенезу людини.

Мета дослідження. З'ясувати хронологічну послідовність розвитку і становлення топографо-анатомічних взаємовідношень яєчників упродовж перинатального періоду онтогенезу людини.

Матеріали і методи. Дослідження проведено на 35 препаратах трупів плодів людини із музею кафедри анатомії, клінічної анатомії та оперативної хірургії Буковинського державного медичного університету (БДМУ). Кожну з груп було розподілено на 7 підгруп відповідно 10 місяцям плодового періоду розвитку (з 4-го по 10-й). Морфологічне дослідження виконували шляхом звичайного і тонкого препарування, виготовлення топографо-анатомічних зрізів, тривимірного комп'ютерного реконструювання внутрішніх жіночих статевих органів, на кожному місяці перинатального періоду. У процесі проведення дослідження автори дотримувалися всіх належних етичних норм (Протокол комісії з біоетики БДМУ № 6 від 20.12.2024 р.). Проведено статистичну

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обробку отриманих результатів методами описової статистики, зокрема: вимірювали основні показники центральної тенденції (середнє), показники розсіювання (середньоквадратична похибка) та візуалізували основні тенденції за допомогою графіків. Для порівняння двох незалежних груп використовували непараметричний U-критерій Манна-Уїтні, оскільки дані не відповідали нормальному розподілу. Дослідження виконувалось у рамках комплексної НДР кафедри анатомії людини ім. М. Г. Туркевича Буковинського державного медичного університету: «Морфо-функціональні особливості розвитку органів та систем в межах топографоанатомічних ділянок в онтогенезі людини», № держреєстрації: 0125U002137 (01.01.2025-31.12.2029 рр.)

Результати. Результати проведеного дослідження дозволили встановити низку закономірностей розвитку яєчників у перинатальному періоді. Виявлено як топографічні, так і морфологічні зміни цих органів. У процесі розвитку їх положення змінюється від висхідного до горизонтального через проміжне розташування в прямокишково-матковому заглибленні. Водночас форма яєчників трансформується з видовженої трикутної до видовженої овальної, при цьому поступово зникає їх сегментарна будова.

Крім того, визначено періоди прискореного та уповільненого зростання морфометричних параметрів яєчників. Найбільш інтенсивне збільшення їх довжини відбувається у проміжках між 4-5 та 8-9 місяцями внутрішньоутробного розвитку. Товщина яєчників найактивніше зростає в період між 8-м і 9-м місяцями, тоді як ширина органів демонструє найбільш виражене збільшення між 4-5 та 9-10 місяцями розвитку.

Висновки. 1. Встановлено періоди інтенсивного збільшення морфометричних параметрів яєчників – 5-6 та 9-10 місяці. 2. Виявлено несинхронне опускання правої та лівої маткових труб у тазову порожнину, яке співпадає з переміщенням яєчників через тісні синтопічні зв'язки. 3. Інтенсивне заповнення кишечника меконієм у поєднанні зі збільшенням товщини матки та ростом яєчників сприяє їх переміщенню у тазову порожнину та витісненню з прямокишково-маткової заглибини. 4. Яєчники у плодів 4-6 міс. мають форму сплощеної видовженої тригранної піраміди з товщиною від 0,96 ± 0,05 мм на 4-му міс. до 2,00 ± 0,42 мм на 6-му міс. На 7-8 міс. внутрішньоутробного розвитку яєчники набувають видовженої округлої форми з товщиною від 2,02 ± 0,43 мм на 7-му міс. до 4,08 ± 0,33 мм на 8-му міс. 5. Для плодів 4-7 міс. характерне висхідне положення яєчників, при якому правий і лівий яєчники досягають сліпої та низхідної ободової кишок відповідно. У плодів 8-10 міс. яєчники переважно займають низхідне положення. Переміщення яєчників у висхідному напрямку супроводжується відносним уповільненням зростання їх морфометричних показників: довжина, ширина та товщина у плодів з 5 до 8 міс. достовірно не різняться. Під час періоду прискореного розвитку яєчників морфометричні показники їх ширини у плодів 9 та 10 міс. достовірно різняться ($p<0,001$). Упродовж перинатального періоду онтогенезу відбувається зміна скелетотопії яєчників: від рівня V поперекового хребця на початку плодового періоду до II крижового хребця у новонароджених.

Ключові слова: морфогенез; плід; морфометрія; яєчники; таз; черевна порожнина; анатомія; морфологія.

Contact information:
Dmytro Proniaiev – Doctor of Medical Sciences, Professor, Professor at the Department of Human Anatomy named after M. G. Turkevych, Bukovinian State Medical University, (Chernivtsi, Ukraine)
e-mail: proniaiev@bsmu.edu.ua
ORCID ID: https://orcid.org/0000-0001-8096-4640.
Scopus Author ID: https://www.scopus.com/authid/detail.uri?authorId=57226622413
Researcher ID: D-4218-2017

Mykola Yasinskyi – Doctor of Philosophy, Assistant Professor atthe Department of Human Anatomy named after M. G. Turkevych, Bukovinian State Medical University, (Chernivtsi, Ukraine)
e-mail: jasinskii.m@bsmu.edu.ua
ORCID ID: https://orcid.org/0000-0001-9594-0940
Researcher ID: PGS-8052-2026

Vladyslav Penteskul – 6th-year student of Bukovinian State Medical University, (Chernivtsi, Ukraine)
e-mail: penteskul.vladislav.med@bsmu.edu.ua
ORCID ID: https://orcid.org/0009-0009-4332-3161

Maryna Kavun – Candidate of Medical Sciences, Associate Professor of the Department of Fundamental General Scientific Disciplines Kharkiv International Medical University, (Kharkiv, Ukraine)
e-mail: marinakvn8@gmail.com
ORCID ID: https://orcid.org/0000-0002-0948-2179
Scopus Author ID: 60001474900
Researcher ID: C-8400-2017

Natalia Yemelianenko – Assistant at the Department of Human Anatomy named after M. H. Turkevych, Bukovinian State Medical University, (Chernivtsi, Ukraine)
e-mail: jemjelianenko@bsmu.edu.ua
ORCID ID: https://orcid.org/0000-0002-7610-3474
Scopus Author ID: 57561139700
Researcher ID: C-9975-2017

Контактна інформація:
Проняєв Дмитро Володимирович – д.мед.н., професор, професор кафедри анатомії людини ім. М. Г. Туркевича Буковинського державного медичного університету (м. Чернівці, Україна)
e-mail: proniaiev@bsmu.edu.ua
ORCID ID: https://orcid.org/0000-0001-8096-4640.
Scopus Author ID: 57226622413
Researcher ID: D-4218-2017

Ясінський Микола Миколайович – д-р філософії, асистент кафедри анатомії людини ім. М. Г. Туркевича Буковинського державного медичного університету (м. Чернівці, Україна)
e-mail: jasinskii.m@bsmu.edu.ua
ORCID ID: https://orcid.org/0000-0001-9594-0940
Researcher ID: PGS-8052-2026

Пентескул Владислав Ілліч – студент 6-го курсу Буковинського державного медичного університету, (м. Чернівці, Україна)
e-mail: penteskul.vladislav.med@bsmu.edu.ua
ORCID ID: https://orcid.org/0009-0009-4332-3161

Кавун Марина Павлівна – кандидат медичних наук, доцент, доцент кафедри фундаментальних загальнонаукових дисциплін ПВНЗ Харківський міжнародний медичний університет, (м. Харків, Україна)
e-mail: marinakvn8@gmail.com
ORCID ID: https://orcid.org/0000-0002-0948-2179
Scopus Author ID: 60001474900
Researcher ID: C-8400-2017

Ємєльяненко Наталія Романівна – асистент кафедри анатомії людини імені М. Г. Туркевича Буковинського державного медичного університету, (м. Чернівці, Україна)
e-mail: jemjelianenko@bsmu.edu.ua
ORCID ID: https://orcid.org/0000-0002-7610-3474
Scopus Author ID: 57561139700
Researcher ID: C-9975-2017

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