DDC-UDC UDC: 611.212.5.013:612.63.025.2 DOI:10.19221/201923

Yemelyanenko N.R.,
Banul B.Yu.
M.G. Turkevych Department of Human Anatomy Higher State Educational Establishment of Ukraine "Bukovinian State Medical University", Chernivtsi, Ukraine

TOPOGRAPHIC-ANATOMICAL PECULIARITIES OF THE NASAL SEPTUM RUDIMENT DURING THE EMBRYONIC PERIOD OF HUMAN ONTOGENESIS

Abstract. *12 specimens of the nasal portion during the embryonic period of human ontogenesis were examined by means of micro- and macrodissection and morphometry as well as regularities of its development, formation and morphological transformations of the human nasal portion. At the end of the embryonic period the primary nasal cavity was found to be formed separated by the primary palate from the primary oral cavity. The nasal septum is formed by means of joining median nasal processes. The permanent palate begins to emerge in the form of the palatine projection (in the right).*
Key words: *nasal cavity, embryo, intrauterine period, ontogenesis.*

Introduction. Review of the scientific literature is indicative of a number of studies dealing with investigation of the structural organization of the nasal walls and the structures adjacent with them [1, 2]. At the same time, there is a lack of information concerning topographic-anatomical peculiarities of the structure and changeability of the nasal structures at different age periods. The nose, as a topographic-anatomical object of the face, is one of its most important elements and considerably forms general perception of a man [3].

The questions concerning the sources of origin, terms of anlage, mechanisms of development and peculiarities of the nasal cavity structure at different age periods remain disputable [4]. Investigation of its age morphology is an important issue for clinicians, since during the period of organ formation their interrelations with the adjacent structures of the facial portion change rather quickly. It requires a special approach to understanding pathological process, its spread, and selection of the most rational and effective methods of treatment and prevention of possible complications of the adjacent portions [5].

Development of new methods in operative surgery requires their anatomical substantiation. Therefore, development of microsurgical anatomy as an anatomical base in the development of microsurgery is absolutely logical. Microsurgical anatomy is a direction of clinical anatomy dealing with the study of structure and topography of small anatomical structures of the organs and parts of the body in the norm and pathology concerning microsurgery requirements [6].

Objective: to study spatial-temporal dynamics of the formation of the constituent elements of the nasal cavity during the embryonic period of human ontogenesis.

Materials and methods. 12 specimens of the nasal cavities of human embryos from 5,0 mm to 13,0 mm of PCL were examined. A complex of up-to-date methods of morphological examination was applied including micro- and macroscopy, anthropometry, morphometry and statistical analysis.

Results and discussion. Examination of 10 series of histological specimens found that on the 4th week of the intrauterine development (embryos with 5,0 – 5,5 mm of the parietal-coccygeal length (PCL)) the oral fossa is determined surrounded superiorly by the unpaired frontal process, inferiorly – by the cardiac projection, and laterally – by the maxillary processes. Its posterior border is formed by the mandibular arch.

The nasal cavity as it is does not exist yet. Though, downward and from the sides of the frontal tuber the epithelial cells are densely located, forming two thickened laminae represented by 4-5-rows of the columnar epithelium. The nuclei of its cells are spherical or elongated in shape, they occupy a central position. On the periphery of the laminae the epithelial cells extend above the ectodermal layer forming an elevation.

In the area of the middle part of the above

thickened portions of the epithelium in the embryos with 6,0 mm of PCL inconsiderable protrusion of the epithelium occurs into the underlying mesenchyme – it is the primary stage of the olfactory placode rudiment located in the cranial-caudal direction. They are 118 ±1,0 mcm long, and 64 ±0,5 mcm wide. The epithelium of the olfactory placodes is 20 ±0,3 mcm thick, in some places – 24 ±0,3 mcm. The distance between their medial borders is 1,1 ±0,1 mm.

The second epithelial thickness is located a little dorsally and laterally from the olfactory placodes. It consists of cylindrical cells which nuclei form 5-6 lines. This thickening extends into the underlying mesenchyme and is the rudiment of the lens placodes located at the distance of 330 ±10,0 mcm from the nasal placode.

The maxillary processes are located lower from the nasal placodes. They grow in the direction to the medium line. At this stage of development the distance between them is 880 ±10,0 mcm. Their lateral border is 160 ±6,0 mcm high, and the free medial border is not higher than 88 ±2 mcm.

Examination of histological sections of the embryos 7,0-7,5 mm long (the fifth week of the intrauterine development) found that epithelial protrusion of the nasal placodes becomes more pronounced, and depressions are formed on the free surface of the placodes – it is the primary stage of the olfactory fossa formation. The walls of the latter are formed by 4-6-row cylindrical epithelium 36 ±2,0 mcm thick with oval dark stained nuclei. The number of nuclei rows gradually decreases to 1-2 to the periphery. The nasal placodes are 60 ±2,0 mcm deep in the embryos 7,1 mm long, and 188 ±10,0 mcm long – in the embryos 7,5 mm long. The distance between the medial borders of the middle nasal processes is 1,1 ±0,1 mm.

Inconsiderable conglomeration of the blood corpuscles are found in the mesenchyme layer – the islets of the internal organ blood formation. In some places they are separated from the surrounding mesenchyme by one layer of the elongated cells, which should be considered as the primary stage of formation of the vascular endothelial lining. In addition to the above, fine conglomerations are found in the form of 3-5 cells, and even separate cells of the erythroblast type.

At this stage of development the sizes of the nasal processes enlarge. These processes grow in the caudal direction and hang over the primary oral cavity.

The olfactory fossae are lined with the cylindrical epithelium 36 ±2,0 mcm thick. Its nuclei are arranged in 4-6 rows. The nasal/olfactory fossae are 96 ±5,0 mcm deep, 180 ±6 mcm high and – 96 ±4,0 mcm wide. The distance between them is 1,2 mm.

The transverse size of the median nasal processes in embryos 8,8 mm is 264 ±10,0 mcm, the vertical one – 286 ±10,0 mcm; in the lateral nasal processes they are 220 ±3,0 mcm and 242 ±8,0 mcm respectively. The median nasal processes come closer together gradually. The distance between them in embryos 8,8 mm becomes shorter to 1,08 mm.

The maxillary processes are located downward and laterally from the nasal processes. The maxillary processes grow medially and forward. They come closer to the lateral nasal processes, but at this stage of development they are not connected yet. They are separated by a small slit passing to the eye rudiment.

An intensive growth of the nasal fossae and adjacent structures occur in embryos 9,5-10,0 mm long. Due to their intensive growth and epithelial protrusion into the underlying mesenchyme they are transformed into the nasal chambers or cells growing in a dorsal direction and a little caudally (in the direction to the primary oral cavity), but they are not connected yet. The nasal cells are lined with the high stratified cylindrical epithelium with unchanged thickness.

The islets of the internal organs formation of a various shape are detected in the mesenchyme. Some of them are located in the form of a chain resembling capillaries. A small concentration of the islets is seen from the side of the epithelial protrusion and in the area of the median nasal processes.

On histological sections the nasal cells are semilunar in shape open into the side of an opposite cell. Their caudal extremities are located closer one to another than the cranial ones, as they have been before. The nasal cells are 540 ±20,0 mcm deep. They are located at the distance of 150 ±6,0 mcm from the primary oral cavity and separated from the latter by the mesenchyme layer 100 ±5,0 mcm thick, placed between the epithelium lining the nasal cells and the epithelium

lining the primary oral cavity. The height and width of the nasal cells do not change practically: they are 200 ±10,0 mcm high (in embryos 8,0 mm long – 180 ±5,0 mcm) and 100 ±10,0 mcm wide (in embryos 8,0 mm long – 9,6 mm). The internal surface of the nasal cells is smooth.

The anterior-posterior axis of the nasal cells is oblique. Their primary (anterior) portions are located one from another at the distance of 1,2 mm, and their blind (posterior) extremities – at 1,1 mm.

At this stage of development the nasal processes enlarge considerably, especially the median ones. Their transverse size is 660±20,0 mcm, the vertical one – 750±25,0 mcm. The sizes of the lateral nasal processes are 440±10,0 mcm and 418±10,0 mcm respectively. At the earlier stages the nasal processes of embryos are presented by the mesenchyme covered with the external layer of the epithelial cells with the nuclei placed in 1-2 rows.

On the medial surface of each median nasal processes there is well marked projection. Therefore, the above processes gradually come closer together. Though, the distance between them remains considerable – 880±20,0 mcm. The median and lateral nasal processes outline the primary nostrils by means of the surfaces turned one to another. The primary nostrils still remain open-ended downward, since the maxillary processes growing to the median line and forward are not yet connected with the nasal processes.

In embryos 11,0-12,0 mm long the nasal cells grow further – dorsally and a little caudally in the direction to the primary oral cavity. Though, at this stage of development they are not connected yet. During the above stages the nasal cells close blindly. They are located at the distance of 80±3,0 mcm from the primary oral cavity. They are 580 ±20,0 mcm deep, and 220±10,0 mcm high.

The superior, inferior and lateral walls of the nasal cells are smooth. Depressions (Jacobson's organ rudiment) appear on the medial wall, in its middle portion.

The median nasal processes are directed downward and laterally. Their transverse size in the embryo 12,0 mcm long is 920±30,0 mcm, and they are 780 ±20,0 mm wide. The lateral nasal processes are 850±20,0 mcm long and 600±10,0 mcm wide. They are directed downward and medially. The distance between the median nasal processes turned one to another is 850±20,0 mcm.

The maxillary processes continue to grow. Their anterior-posterior size increases to 1,5 mm and their height – to 750±10,0 mcm. At this stage of development they are connected with the lateral nasal processes, and their free border is located near the inferior extremity of the median process.

At the end of the embryonic period (embryos with 13,0-13,5 mm of PCL) the nasal cells penetrate into the primary oral cavity. Due to this fact the primary nasal cavity, oral cavity and pharynx are connected. It should be noted that penetration of the nasal cells into the primary oral cavity occurs in the embryos 11,5 mcm long of the intrauterine development.

The study of the nasal portion of the embryos with 13,5 mm of PCL demonstrated that both halves of the primary nasal cavity are of a bent shape - first directed dorsally, later – a little caudally (in the direction of the primary oral cavity), and they open near its lateral walls. The anterior-posterior size of the primary nasal cavity is 690±20,0 mcm.

If in embryos with 10,0 mm of PCL the difference between the superior and inferior extremities of the nasal cells is not considerable, in embryos with 13,0 mm of PCL the superior extremities of both halves of the primary nasal cavity are separated one from another more than the inferior ones. The distance between the former is 1,3 mm, and the latter – 990±20,0 mcm. The height of the primary nasal cavity is no more than 660±10,0 mcm, and the width – 180 ±5,0 mcm. Every half of the primary nasal cavity begins with the opening in front (primary nostril), which is limited laterally by the lateral nasal process 770±10,0 mcm long and 550 ±10,0 mcm wide, and medially – by the anterior border of the nasal septum formed due to connection of the median nasal processes. The vertical size of the nasal septum is 660±10,0 mcm, the transverse one – 880±15,0 mcm and the anterior-posterior one – 484±10,0 mcm.

In the area of the primary nostrils the transition of the ectodermal epithelial cells, with the nuclei located in 1-2 rows, into the high stratified cylindrical epithelium lining the primary nasal cavity with the nuclei located in 5-6 rows is well marked. Externally from the epithelium there is a layer of mesenchyme cells containing practically

continuous chain of islets of the internal organ blood formation. A part of them is separated from the surrounding mesenchyme by one row of cells of an elongated shape of an endothelial type.

In the dorsal direction the vertical size of the primary nasal cavity decreases gradually, and in the places of protrusion into the primary oral cavity the primary choanas (posterior nostrils) of a spherical or elongated in the vertical direction shape are formed. Their sizes are 200 x 200, or 220 x 230 mcm. The distance between the primary choanas is no longer than 880±10,0 mcm.

The anterior-posterior axes of the both halves of the primary nasal cavity are located in an oblique direction.

The primary nasal cavity is separated from the primary oral cavity by the primary palate 286±8,0 mcm thick, 1,1 mm wide and 280±6,0 mcm long.

At this stage of development a small projection appears in the right of the lateral wall of the primary oral cavity – the rudiment of the palatine process.

The projection looks like an inconsiderable protrusion into the primary oral cavity of the maxillary process mesenchyme covered with 3-4 rows of the epithelium. On the frontal sections it looks like a cone with its apex directed to the tongue and located on the level of its inferior border.

The palatine process is 200±5,0 mcm high, its anterior-posterior size is 420±7,0 mcm, its free extremity penetrates 100±4,0 mcm into the primary oral cavity.

All the walls of the primary nasal cavity are smooth. The maxillary processes have already connected with the lateral nasal processes, though they are not completely closed.

Conclusions. 1. At the end of the embryonic period the primary nasal cavity is formed separated from the primary oral cavity by the primary palate. 2. The nasal septum is formed by means of junction of the median nasal processes, and the permanent palate begins to form in the shape of the palatine projection (in the right).

Prospects of further studies: to investigate peculiarities of the development of the nasal portion structures and nasal septum during the pre-fetal period of human ontogenesis.

References

1. von Arx T, Lozanoff S, Bornstein MM. Extraoral anatomy in CBCT – a literature review. Part 1: Nasoethmoidal region. Swiss Dent J. 2019 Aug 8;129(10).

2. Kim SA, Jang YJ. Caudal Septal Division and Interposition Batten Graft: A Novel Technique to Correct Caudal Septal Deviation in Septoplasty. Ann Otol Rhinol Laryngol. 2019 Aug 6:3489419866214. doi: 10.1177/0003489419866214.

3. Gore MR. The supraseptal ethmoid sinus cell: A previously unreported ethmoid sinus variant. Clin Case Rep. 2019 May 20;7(7):1306-1308. doi: 10.1002/ccr3.2215.

4. Li W, Lu H, Zhang H, Lai Y, Zhang J, Ni Y, Wang D. Sinonasal/nasopharyngeal pleomorphic adenoma and carcinoma ex pleomorphic adenoma: a report of 17 surgical cases combined with a literature review. Cancer Manag Res. 2019 Jun 17;11:5545-5555. doi: 10.2147/CMAR.S198942.

5. Sousa Menezes A, Costa NDRMD, Moreira FC, Ribeiro D. Incisive dental implant migration into the nasal septum. BMJ Case Rep. 2019 Jul 27;12(7). pii: e228325. doi: 10.1136/bcr-2018-228325.

6. Karataş M, Olt S. Does Septoplasty Affect Hemoglobin and Erythropoietin Levels in Patients With Nasal Septal Deviation? J Craniofac Surg. 2019 Jul;30(5):e436-e439. doi: 10.1097/SCS.0000000000005474.