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RESEARCH ARTICLE

Macromicroscopic Characteristics of Individual and Aged Variability of the Glands of the Vaginal Vestibule

Shadlinskaya SV*

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Abstract

Aim: To obtain data on the age and individual characteristics of the glands of the vaginal vestibule in postnatal human ontogenesis.

Materials and Research Methods: By the macromicroscopic way, the small glands of the vaginal vestibule wall were investigated in cadavers of 163 women of different ages without pathology of the urogenital system. The total number, length, width, density of location, the area of the initial section, the diameter of the common excretory duct of the glands, the number of glands with ampoule-widened excretory ducts, and glands were determined.

Results: The conducted macro-microscopic examination made it possible to reveal that the maximum number and size of small vestibular glands are determined in the 1st period of adulthood. Starting from the 2nd period of adulthood and up to senile age inclusive, there is a decrease in these indicators. The minimum level of individual variability in the size and number of small glands of the vestibule is characteristic in ontogeny for the neonatal period.

Key Words: *Glands; Vaginal vestibule; Total preparations; Common excretory duct; Initial parts*

Introduction

Morphological exocrinology is in the focus of the attention of anatomists, histologists, pathologists, and clinicians of various specialties. This is due not only to the need to expand theoretical knowledge, but also to decipher the pathogenesis of numerous nosological forms, in the development of which the small glands of hollow organs are involved [1].

The glands, outside of their organ and systemic localization, are the starting point (source) of the development of adenocarcinomas, adenomas, retention cysts, pseudodiverticula, and many other diseases [2].

Currently, there is a high incidence of candidiasis and mixed vulvovaginitis [3], bacterial vaginosis [4], genital endometriosis [5], and other specific diseases.

Malignant tumors of the vagina are characterized by frequent rapid growth and metastasis [6], lead to a deterioration in the quality of life and often lead to death [7]. As is known, the source of adenogenic vaginal cancer is the epithelium of the small vaginal glands [8]. The glands of the vaginal vestibule are also affected by fibroadenomatous pathology [9], they are exposed to abscesses, diverticulitis [10], and polyps of the vestibule of the vagina are not uncommon [11].

Despite this, among the meager work carried out on the study of the glands of the genitourinary apparatus, there is almost no work on the topic of the glands of the vaginal vestibule. The only targeted research on the macromicroscopic anatomy of the vestibular small glands was carried out only in the middle of the XX century [12]. Thus, the data on the patterns of morphology and morphogenesis of the glands are not only of theoretical importance but

Associate professor, Department of Human anatomy and Medical terminology, Azerbaijan Medical University, Baku, Azerbaijan.

**Corresponding author: Shadlinskaya SV, Associate professor, Department of Human anatomy and Medical terminology, Azerbaijan Medical University, Azerbaijan, Baku, AZ 1078, MohsunSanani str.1/38, Azerbaijan, Tel: +994 516820871; E-mail: shadli-vaqif@mail.ru*

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also fundamentally important for the development of clinical medicine.

Despite this, there are almost no data in the scientific literature on the age and individual characteristics of the small glands of the vaginal vestibule.

Material and Methods

By the macromicroscopic way, the small glands of the vaginal vestibule wall were investigated in 163 women of different ages who died or died from accidental causes, without pathology of the urogenital system. On the cadavers, the area of the vaginal vestibule was excised by dissection. On the preparations obtained, the vaginal vestibules were stained according to the method of R.D. Sinelnikov [13]. For this, the vaginal area was excised from the cadaver by dissection. To make a total preparation, the actual material was placed in a 0.5% solution of acetic acid with 0.05% methylene blue solution in tap water. The glands in this solution were stained for 24-36 hrs. Then, within 24-30 hours, the total vaginal preparation was fixed in a saturated solution of ammonium molybdate. Then the preparation was placed in glycerol and fixative solution, where the bleached preparation was preserved.

On total preparations, the glands were examined in transmitted and reflected light using a forehead magnifier and an MBS-9 microscope (magnification 8-64x). The vaginal vestibule was preliminarily divided by transverse threads into anterior, middle, and posterior thirds. All measurements of the study were taken separately in the above zones.

During the macromicroscopic study, the total number of glands, the number of glands with ampoule-widened excretory ducts, the number of glands with ampoule-widened excretory ducts, and the density of the glands were counted.

The length, width, area of the initial department and the diameter of the common excretory duct were measured. We also analyzed the percentage of glands with a different number of initial departments (the total set of glands on the total preparation was taken as 100%).

The digital data obtained during the study were subjected to statistical processing. The mean values of the obtained samples (M), standard errors (m), minimum (min), maximum (max) values of the series were calculated. A comparison was made between groups (P), sequentially within a group (P0), within a group with the first parameter (P1), within a group with a maximum (P2). For a preliminary assessment of the difference between the variation series, the parametric Student's t-test was used. Further, to compare and determine the reliability of quantitative differences in groups and subgroups, the nonparametric rank U-Wilcoxon (Mann-Whitney) test was used [14].

The calculations were carried out in the programs of the statistical package MS EXCEL-2016 and SPSS-22.

Research Results

Glands on total preparations are defined as dark anatomical formations located on a lighter background of the surrounding wall. The contours of the glands are well defined. They are present both in the anterior (closest to the external opening of the urethra) and in the middle and posterior (closer to the anus) thirds of the wall of the vaginal vestibule. The glands are located singly or in groups and do not form longitudinal rows.

At the macro-microscopic level, the initial departments and excretory ducts are revealed in the glands. The shape of the initial departments of the glands is diverse, more often ovoid or rounded (Figure 1). On a number of preparations, at high magnification, the initial parts are determined in the initial department, which have compact rounded contours. Sometimes the initial departments form clusters (complexes).

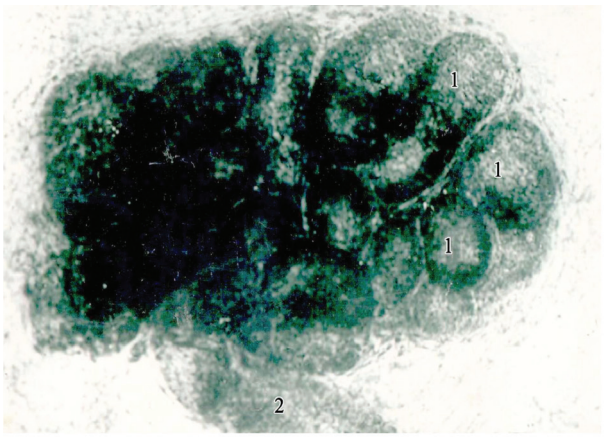

Figure 1) *The initial parts of the initial department of the ovoid shape in the walls of the vaginal vestibule (middle third) of a 42-year-old woman. Total preparation, staining by R.D. Sinelnikov. Magnification X60. Note: 1. Initial parts; 2. Common excretory duct*

If one gland has several initial departments, the excretory duct of the 1st order departs from each of them. When these ducts are connected, a common excretory duct is formed, which opens with a rounded, oval, or slit-shaped mouth on the surface of the integumentary epithelium.

Initial departments of various numbers are identified in the composition of glands. Their number varies from one up to four or six and more. According to our data the maximum number of initial departments of single gland reaches 15. S-shaped curvatures form along the common excretory duct of some number of the small glands of the vestibule (12.5 ± 0.5% in newborns; 23.4 ± 1.2% at 1st period of adulthood; 34.2 ± 2.3% at senile age) (Figure 2).

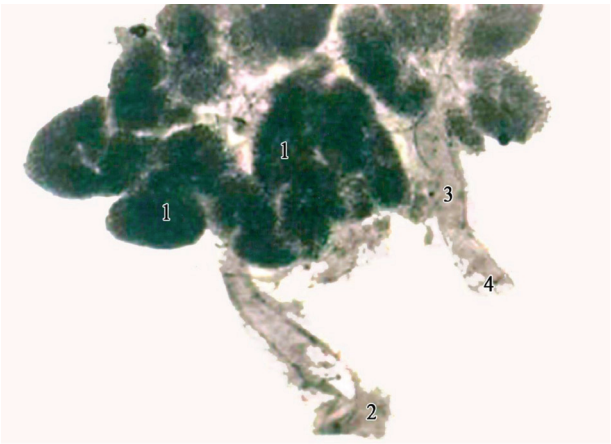

Figure 2) *Initial departments of different small glands of the vaginal vestibule (posterior third) in a 45-year-old woman. Total preparation, staining according to R.D. Sinelnikov. Magnification X60. Note:1. Initial parts; 2. S-shaped curvature of the common excretory duct; 3. Common excretory duct; 4. The orifice of the common excretory duct.*

The results of a study of the age characteristics of the glands of the vaginal vestibule in women normally showed that the glands are constantly (in 100% of cases) determined already in newborns. In newborn girls, there are 54 ± 1.74 glands in the walls of the vaginal vestibule (from 41 to 62 individually). The density of the glands at this age is higher during postnatal ontogenesis (3.7 ± 0.17 glands on an area of 0.5 cm^2). The length of the initial department of the glands at this age is 0.19 ± 0.01 (0.16-0.22) mm, the width is 0.16 ± 0.01 (0.12-0.19) mm, the area (on the transverse section) - 400.2 ± 18.3 mm^2 10^{-4}, the diameter of the common excretory duct - 23.6+0.64 μm.

At this age, the glands are rather uniform in shape. Glands with one initial department prevail (87.9 ± 1.1%). Glands with two initial departments are detected in 5.7 ± 0.2%, with three-in 3.7 ± 0.3%. Glands with four initial departments (complex form) are rarely detected - in 2.7 ± 0.5%.

The number of glands of the vaginal vestibule in early childhood by 1.5 times (P <0.05), in adolescence by 2.0 times (P <0.05), and in the 1st period of adulthood by 2.8 times (P <0.05) is more than in newborns. This parameter in elderly age is 1.4 times (P <0.05), in senile age, it is 1.7 times (P <0.05) less than in the 1st period of adulthood (Table 1).

The density of localization of glands compared to newborns in early childhood is 1.03 times (P2> 0.05), at puberty - 1.1 times (P> 0.05), in 1st period of adulthood - 1.1 times (P> 0.05), at elderly age 1.4 times (P <0.05), in senile age 2.6 times (P2 <0.05) decreases (diagram).

The diameter of the common excretory duct of the glands compared with newborns in early childhood 1.3 times (P <0.05), at puberty 1.4 times (P <0.05), at the 1st period of adulthood in 1.7 times (P <0.05), at elderly and senile ages 1.8 times (P <0.05) increases.

Thus, throughout the entire postnatal development of a person, the density of localization of small glands of the vaginal vestibule decreases, and the diameter of the common excretory duct increases.

The length of the initial section of the glands in girls of early childhood is 1.4 times (P <0.05), at puberty 2.6 times (P <0.05), and in women at the 1st period of adulthood, 3.7 times (P <0.05) more than in newborns. This indicator for the glands of the vaginal vestibule at the elderly age is 1.3 times (P <0.05), at senile age is 1.6 times (P <0.05) less than in women at the 1st period of adulthood (Table 2).

According to the data obtained, the width of the initial department in early childhood in is 1.4 times (P <0.05), at puberty - 2.6 times (P <0.05), at the 1st period adulthood 3.5 times (P <0.05) more than newborn girls. This indicator at the elderly age 1.3 times (P <0.05), at senile age 1.4 times (P <0.05) is less than in the 1st period adulthood.

The area of the initial department of glands increases in early childhood by 1.2 times (P> 0.05), at puberty by 1.7 times (P1> 0.05), at the 1st period adulthood by 2.2 times (P> 0.05), compared with newborn girls. In comparison with the 1st period adulthood, the considered indicator at elderly aged women decreases 1.4 times (P> 0.05), at senile age - 1.4 times (P> 0.05).

TABLE 1

The total number of small glands of the vaginal vestibule (the number of orifices of the excretory ducts on the surface of the mucous membrane) in women of different ages.

Age	N	Part of the vaginal vestibule. the number of the small glands			
		Anterior third	Middle third	Posterior third	The vaginal vestibule in general
Newborns (from 1 to 10 days)	7	14 ± 0.81	18 ± 0.54□	22 ± 0.56□	54 ± 1.74
		18-Aug	16-22	16-26	41-62
Infancy (from 10 days to 1 year)	5	18 ± 0.62	24 ± 0.75□	26 ± 0.87□	68 ± 1.74
		23-Dec	16-29	18-33	48-77
Early childhood (1-3 years)	5	22 ± 1.09	28 ± 1.18□	32 ± 1.50□	82 ± 4.62*
		15-26	21-33	24-39	69-111
1st childhood (4-7 years)	6	23 ± 0.87	30 ± 1.09*□	36 ± 1.61□	89 ± 5.35*
		17-26	24-35	26-42	73-126
2nd childhood (8-11 years)	6	25 ± 1.1*	35 ± 1.45*□	42 ± 1.31*□	102 ± 5.12*
		19-28	25-39	35-49	79-128
Puberty (12-15 years)	5	28 ± 1.11*	36 ± 1.02*□	44 ± 1.11*□	108 ± 4.50*
		22-35	32-42	36-49	81-133
Adolescence (16-20 years)	6	30 ± 0.35*	38 ± 0.47*□	47 ± 0.65*□	115 ± 2.75*
		26-34	33-45	38-54	92-157
1st adulthood (22-35 years)	8	36 ± 0.55*	52 ± 0.46*□	64 ± 0.72*□	152 ± 2.70*
		28-42	45-56	52-69	121-185
2nd adulthood (36-55 years)	8	32 ± 0.37*	43 ± 0.41*□	54 ± 0.75*□	129 ± 1.16*
		25-36	37-49	46-67	111-142
Elderly (56-74 years)	9	24 ± 0.41´	36 ± 0.42*´□	45 ± 0.50*´□	105 ± 1.16*´
		18-31	28-43	35-52	86-124
Senile (75-90 years)	9	18 ± 0.36´	32 ± 0.41*´□	39 ± 0.63*´□	89 ± 1.61*´
		13-24	26-38	30-48	68-113

Note: Here and in the following table means: 1. n-number of observations; 2. Statistically significant difference within the group with the first parameter: * – P_1 <0.05; ** – P_1 <0.01; *** – P_1 <0.001; 3. Statistically significant difference within the group with a maximum: ´ – P_2 <0.05; ¨ – P_2 <0.01; ´ –P_2 <0.001; 4. Statistically significant difference between groups: □ – P <0.05; □□ – P <0.01; □□□ – P <0.001.

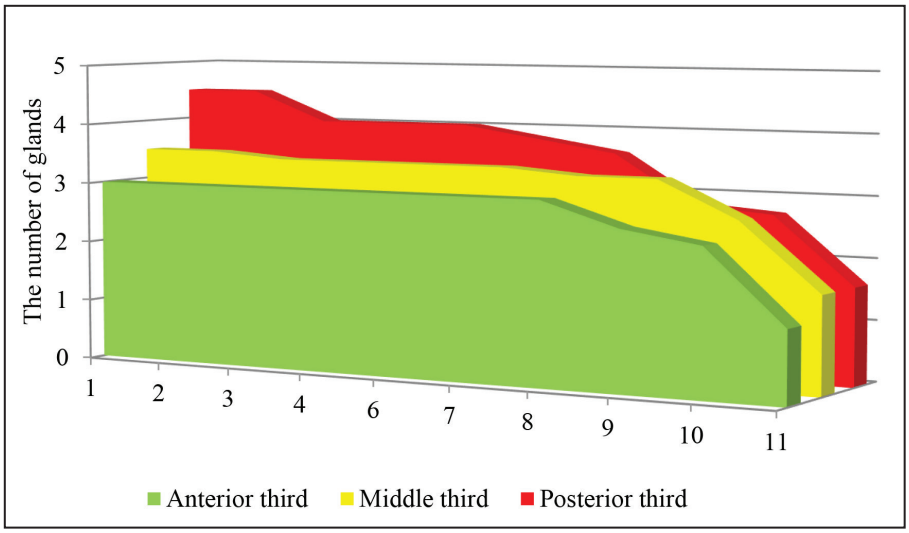

Diagram) *The density of the location of the small glands of the vaginal vestibule (the number of glands in the area of 0.5 cm2 of the wall) in women of different ages.*

Note. Here and in the following figures, the abscissa shows data by age group:

1. New borns (from 1 to 10 days); 2. Infancy (from 10 days to 1 year); 3. Early childhood (1-3 years); 4. 1st childhood (4-7 years); 5. 2nd childhood (8-11 years); 6. Puberty (12-15 years); 7. Adolescence (16-20 years); 8. 1st adulthood (22-35 years); 9. 2nd adulthood (36-55 years); 10. Elderly (56-74 years); 11. Senile (75-90 years)

TABLE 2

The length of the initial department of the small glands of the vaginal vestibule of the vagina in women of different ages (mm).

Age	N	Part of the vaginal vestibule. the length of the initial department of the glands			
		Anterior third	Middle third	Posterior Third	The vaginal vestibule in general
Newborns (from 1 to 10 days)	7	0.11 ± 0.01 0.08-0.14	0.22 ± 0.01□ 0.17-0.26	0.25 ± 0.01□ 0.20-0.29	0.19 ± 0.01 0.16-0.22
Infancy (from 10 days to 1 year)	5	0.16 ± 0.01 0.11-0.21	0.24 ± 0.01□ 0.17-0.28	0.28 ± 0.01□ 0.21-0.33	0.23 ± 0.01 0.18-0.29
Early childhood (1-3 years)	5	0.19 ± 0.01* 0.14-0.25	0.29 ± 0.01□ 0.22-0.35	0.35 ± 0.01□ 0.27-0.38	0.27 ± 0.01* 0.23-0.35
1st childhood (4-7 years)	6	0.24 ± 0.01* 0.18-0.33	0.33 ± 0.01□ 0.26-0.38	0.45 ± 0.01□* 0.31-0.54	0.34 ± 0.01* 0.27-0.41
2nd childhood (8-11 years)	6	0.30 ± 0.01* 0.22-0.43	0.40 ± 0.01*□ 0.27-0.48	0.55 ± 0.01*□ 0.37-0.61	0.42 ± 0.01* 0.30-0.48
Puberty (12-15 years)	5	0.35 ± 0.01** 0.27-0.42	0.48 ± 0.01*□ 0.36-0.55	0.64 ± 0.01*□ 0.50-0.76	0.49 ± 0.01* 0.37-0.59
Adolescence (16-20 years)	6	0.41 ± 0.01* 0.33-0.48	0.55 ± 0.01*□ 0.37-0.66	0.80 ± 0.01*□ 0.64-0.96	0.59 ± 0.01* 0.37-0.72
1st adulthood (22-35 years)	8	0.46 ± 0.01** 0.35-0.54	0.76 ± 0.01*□ 0.54-0.97	0.92 ± 0.01* □ 0.68-1.12	0.71 ± 0.01* 0.55-0.95
2nd adulthood (36-55 years)	8	0.33 ± 0.01* 0.22-0.52	0.70 ± 0.01*□ 0.51-0.87	0.84 ± 0.01*□ 0.68-1.03	0.62 ± 0.01* 0.51-0.85
Elderly (56-74 years)	9	0.28 ± 0.01* ´ 0.18-0.46	0.57 ± 0.01 ´□ 0.26-0.71	0.75 ± 0.02* ´□ 0.37-0.85	0.53 ± 0.01 ´* 0.31-0.73
Senile (75-90 years)	9	0.26 ± 0.01* ´ 0.16-0.42	0.45 ± 0.01 ´□ 0.25-0.60	0.63 ± 0.03* ´□ 0.33-0.83	0.45 ± 0.02 ´* 0.26-0.63

We have identified age-related variability in the percentage of glands with different numbers of initial departments of the glands of the vaginal vestibule. So, the percentage of glands with one initial department in early childhood decreases by 1.1 times (P <0.05), at puberty by 1.4 times (P <0.05), at the 1st period adulthood 1.7 times (p <0.05), compared with newborn girls. In senile age, the percentage of such glands increases by 1.4 times (P <0.05), compared with the 1st period of adulthood.

The relative number of glands with two initial departments in early childhood increases 1.6 times (P <0.05), at puberty - 2.5 times (P <0.05), at the 1st period of adulthood - 4.7 times (P <0.05), compared with newborn girls. This indicator in senile age is 1.4 times less (P <0.05) than in the 1st period of adulthood.

The percentage of glands with three initial departments in early childhood increases by 2.2 times (P <0.05), at puberty - 3.4 times (p <0.05), at the 1st period of adulthood - 4.6 times (P <0.05). In senile age, the content of such glands in the area under consideration decreases by 1.3 times (P <0.05), compared with the 1st period of adulthood.

The percentage of glands with four or more initial departments in early childhood increases by 1.1 times (P <0.05), at puberty - 3.3 times (P <0.05), at the 1st period of adulthood - 5.0 times (P <0.05), compared with newborns. The number of these glands at senile age is 1.9 times less (P <0.05), compared with the 1st period of adulthood.

On total preparations, we studied the percentage (relative) representation of those glands, the common excretory duct of which has a local ampoule-shaped expansion.

According to our data, in newborns and infancy, such glands are absent throughout the vaginal vestibule. In early childhood, the percentage of glands with ampoule-like dilated excretory ducts is 3.9+0.62. The percentage of glands with ampoule-like dilated excretory ducts at puberty is 1.9 times (P <0.05), at the 1st period of adulthood - 5.5 times (P <0.05), in elderly women - 8.9 times (P <0.05), in senile age - 10.5 times (P <0.05) more than in early childhood.

We have found that the number and size of the glands of the vaginal vestibule are individually variable. The level of variability (the amplitude of the variation series of indicators) in the glands predominantly increases during postnatal ontogenesis. For example, compared with newborn girls, the maximum and minimum individual values of the length of the initial department of the small glands of the vaginal vestibule at 22-35 years 1.7 times (P <0.05), the width of the initial department are 1.6 and 1.8 times respectively (P <0.05), the diameter of the common excretory duct are 1.4 and 1.9 times (P <0.05) are larger.

The individual minimum and maximum size-quantitative indicators of the glands in the walls of both the vaginal vestibule, and the anterior, middle, and posterior thirds of it, increase from the neonatal period to the 1st period of adulthood and then decrease to the elderly, senile age.

The amplitude of the variation series of this sign of lymphoid structures in newborn girls, in early childhood, in most cases, is greater than in senile age.

Discussion

The microanatomical and microsyntopic features revealed by us (structure, the shape of glands, and their location) of the glands of the vaginal vestibule are also common for the mucous membranes of other internal organs [15-18]. So, at the macro-microscopic level, the initial departments (one or more) and excretory ducts are revealed in the glands of the vaginal vestibule.

M.R.Sapin, D.B. D. B. Nikityuk, V. B. Shadlinski, N. T. Movsumov et al. (2001) indicate that the excretory duct of the small glands of the walls of hollow internal organs can be preformed anatomically. At the same time, given the asynchronous nature of the secretory process, periodic weakening of secretion (for example, with involution of the glands), and antigenic materials are not always washed out from the lumen of the gland [19].

According to our data, along the common excretory

duct, S-shaped curvatures are formed in a part of the small glands of the vestibule. It is believed that the presence of such curvatures is a compensatory mechanism for the accumulation of secretion (in conditions of age-related hyposecretion of the gland) with its possible simultaneous excretion, if necessary. On the other hand, in the area of ampoule-shaped enlargements, conditions are created for the stagnation of the secretion and its infection [1].

The analysis showed that the small glands of the vaginal vestibule are fully formed by the time the child is born and is capable of active secretion. This is due to a qualitative change in vital activity immediately after birth, the need to implement a protective function to the integumentary epithelium of the vestibule of the vagina (from mechanical damage, microorganisms, etc.).

The study on total preparations of the age characteristics of the glands of the vaginal vestibule showed that from the neonatal period to the 1st period of adulthood, the number of glands, length, width, and area of the initial departments increase. At this age, the shape of the glands is the most diverse, which is also typical for the glands of the majority of the mucous membranes of the hollow organs of the genitourinary apparatus, respiratory and digestive systems [15,17,18,20].

As the research data of A.G. Yakhnitsa (1967) have shown, at this age the most intense secretory activity of the tracheal glands and main bronchi are observed [21]. Starting from the 2nd period of adulthood and up to senile age, inclusive, there is a decrease in the indicated size-quantitative indicators of the glands of the vaginal vestibule.

In senile age, the shape of the glands (their exterior) is also simplified - the percentage of glands with three, four or more initial departments (complex-shaped glands) decreases, and the content of simple-shaped glands increases (i.e. with one initial department). Simplification of the "exterior" of the glandular apparatus is also typical for the walls of other hollow internal organs of the genitourinary apparatus, digestive, and respiratory systems [19].

The variability of the dimensional and quantitative indicators revealed by us is also characteristic of other glands of hollow organs. So, according to M.K. Allahverdiyev (2007), B.M. Huseynov (2011), G.A. Huseynova (2013), N. R. Djabbarova (2015) on the shape, size, and the number of glands in the walls of the biliary tract, urinary bladder, female urethra, trachea, and main bronchi are also characterized by significant individual anatomical variability. According to these researchers, the individual structural features of the glands are least pronounced during the neonatal period, and most - in the elderly and senile age [15-18].

Significant individual variability in the shape and size of the glands of the mucous membranes of hollow internal organs is one of the patterns of their morphogenesis. The lower level of individual variability of the dimensional parameters of the glands in newborn girls and early childhood is possibly associated with the uniformity of the child's living conditions (hygiene, use of diapers, bed rest). The maximum level of these indicators, perhaps, depends on the characteristics of personal hygiene, the level of intimate relationships, past diseases, and other factors [1].

Conclusion

Thus, the performed macro-microscopic analysis made it possible to reveal previously unknown facts about the morphogenesis of the small glands of the vestibule and the individual variability of the glandular apparatus.

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