

## PECULIARITIES OF SEMINAL VESICLES AND SEMINAL DUCTS FORMATION

Khmara T. Volodymyrivna<sup>1</sup>, Ryznychuk M. Aleksandrovna<sup>1</sup>, Kryvchanska M. Ivanivna<sup>1</sup>, Zamorsky I. Ivanovich<sup>1</sup>

<sup>1</sup> Higher State Educational Institution of Ukraine "Bukovinian State Medical University", Chernivtsi, Ukraine

### ABSTRACT

**Introduction.** Recently, decrease in male reproductive function has become particularly relevant. Nowadays, 8 to 29% of married couples are infertile throughout the world.

**The purpose** of our study was the ascertainment of the peculiarities of development of seminal vesicles, seminal and ejaculatory ducts.

**Material and methods.** The study was carried out on 16 series of histological sections of pre-fetuses of 10-12 weeks and 4-month fetuses. Nine waxed reconstructions of pelvic organs of pre-fetuses of 65.0 mm paritococcygeal length (PCL) and fetuses of 82.0, 85.0, 95.0 and 130.0 mm PCL were made and studied.

**Results.** In pre-fetuses of 46.0-52.0 mm PCL, the mesonephric duct (wolffian duct) is reduced in the cranial and middle sections. The diameter of the unreduced portion of the wolffian duct at the gonad level varies from 58 to 68  $\mu$ m. At the beginning of the fetal period of ontogenesis, the length of the right seminal vesicle is  $1.56 \pm 0.12$  mm, its width is  $0.54 \pm 0.05$  mm, its thickness is  $0.46 \pm 0.06$  mm. The dimensions of the left seminal vesicle are accordingly:  $1.39 \pm 0.11$ ,  $0.61 \pm 0.05$  and  $0.57 \pm 0.06$  mm. In fetus of 130.0 mm PCL, the seminal vesicles are represented by the main tubule and its branches. The length of the right seminal vesicle is 2.3 mm, and the left is 2.2 mm. The length of the cavity of the main duct of the right seminal vesicle

### RÉSUMÉ

**Particularités de la formation des vésicules séminales et des conduits éjaculateurs**

**Introduction.** Récemment, la diminution de la fonction de reproduction chez les hommes est devenue particulièrement pertinente. Dans de nombreux pays, les couples mariés sont infertiles dans un pourcent de 8 à 29%

**Le but de notre étude** était de découvrir les particularités du développement des vésicules séminales, des canaux déférents et des conduits d'éjaculation.

**Matériel et méthodes.** L'étude a été menée sur 16 séries de coupes histologiques des foetus de 10-12 semaines et de 4 mois. Neuf modèles de reconstruction plastique du bassin prénatal de 65,0 mm. DTR et des foetus de 82,0, 85,0, 95,0 et 130,0 mm. DTR ont été fabriqués et étudiés.

**Résultats de la recherche.** Dans les foetus de 46,0 à 52,0 mm. DTR, le corps de Wolff est réduit dans les divisions crânienne et moyenne. Le diamètre de la partie non réduite du conduit de Wolff au niveau de la glande sexuelle varie de 58 à 68 microns. Au début de la période foetale de l'ontogenèse, la longueur de la vésicule séminale droite est de  $1,56 \pm 0,12$  mm, la largeur est de  $0,54 \pm 0,05$  mm et l'épaisseur est de  $0,46 \pm 0,06$  mm. Les dimensions de la vésicule séminale gauche sont de  $1,39 \pm 0,11$ ,  $0,61 \pm 0,05$  et de  $0,57 \pm 0,06$  mm. Dans le

is 4.6 mm, and 6.4 mm including the branches. The length of the cavity of the main duct of the left seminal vesicle is 4.8 mm, and 5.6 mm including the branches.

**Conclusions.** At the end of the 10<sup>th</sup> – the beginning of the 11<sup>th</sup> week of prenatal development, intensive up-growth of the caudal parts of the mesonephric ducts was noted, resulting in the seminal ducts, seminal vesicles and prostate excretory ducts appearance. In the fetuses of 95.0-120.0 mm of PCL, formation of an ampulla of the seminal duct was observed. At the end of the 4<sup>th</sup> month of prenatal development, the external and internal structure of the seminal vesicles and ampullae of the seminal duct becomes more complicated.

**Key words:** seminal vesicle, seminal duct, ejaculatory duct, morphogenesis.

foetus de 130,0 mm DTR, les vésicules séminales sont représentées par un tube principal et ses branches. La longueur de la vésicule séminale droite est de 2,3 mm, et la gauche est de 2,2 mm. La longueur de la cavité du trajet principal de la vésicule séminale droite est de 4,6 mm. et avec les branches – 6,4 mm. La longueur de la cavité du trajet principal de la vésicule séminale gauche est de 4,8 mm. et avec les branches – 5,6 mm.

**Conclusions.** À la fin de la 10-ème – au début de la 11-ème semaines du développement du fœtus on a marqué un développement intensif des parties caudales des conduits mésonéphriques, ayant comme résultats l'apparition des conduits éjaculateurs, des vésicules séminales et des canaux déférents de la glande de la prostate. Dans les fœtus de 95,0-120,0 mm. DTR on observe la formation d'une ampoule du conduit éjaculateur. A la fin du 4-ème mois du développement du fœtus a lieu la complication de la structure externe et interne des vésicules séminales et des ampoules des conduits éjaculateurs.

**Mots-clés:** vésicule séminale, conduit éjaculateur, canal déférent, morphogénèse.

## **INTRODUCTION**

Recently, decrease in male fertility has become particularly relevant. Nowadays 8 to 29% of married couples are infertile throughout the world<sup>1,2</sup>. Congenital absence (agenesis) of the seminal duct is quite a rare anomaly, which can be one of the causes of male infertility (1-2%). Agenesis of the seminal duct can be either unilateral or bilateral, and be combined with other anomalies of the genitourinary organs, such as cryptorchidism, seminal vesicle (SV) defects, abnormalities of the ejaculatory duct, and kidney anomalies<sup>3,4</sup>.

John Hunter first described the absence of the seminal duct in dead body in 1737, and the agenesis of kidney is indicated by Weiske et al<sup>5</sup>. The prevalence of unilateral agenesis of the seminal duct is 0.06% to 0.8%<sup>6</sup>.

Morphogenesis of the organs of the reproductive system is a process involving many links, extremely sensitive to the action of mutagenic and teratogenic factors, causing the uprising of hereditary and congenital diseases, as well as defects in reproductive function<sup>7,8</sup>.

Some authors<sup>9-11</sup> believe that antenatally damaged systems and organs in postnatal ontogenesis will not be able to function properly, and this in the future can be manifested by early atherosclerosis, endocrinopathies, immunodeficiency states, and sexual disorders.

Therefore, the problem of the sources and time of the appearance of the anlage of SV, the seminal and the ejaculatory ducts, is of great interest to many researchers of various specialties<sup>3,12</sup>. Scientists use different methods of research than can explain this discrepancy, especially in describing the timing of the appearance of the anlage of the above organs. Many questions of morphogenesis and correlative interrelations of the mesonephric and paramesonephric ducts, SV and seminal ducts, the dynamics of their syntopy have not been sufficiently studied, and some of them remain controversial. In studying the topographic-anatomical relationships of microstructures, their general form, invaluable information is provided by the method of making proportionally enlarged reconstructions on a series of histological sections<sup>13</sup>.

**THE PURPOSE** of our study is the ascertainment of the peculiarities of development of SV, seminal and ejaculatory ducts.

## **MATERIAL AND METHODS**

The study was carried out on 16 series of histological sections of pre-fetuses of 10-12 weeks and 4-month fetuses. Nine waxed reconstructions of pelvic organs of pre-fetuses of 65.0 mm parietococcygeal length (PCL) and fetuses of 82.0, 85.0, 95.0 and 130.0 mm PCL are made and studied.

Consecutive study of a series of histological sections makes it possible to draw an approximate idea of the syntopy of adjacent organs and structures, but experience has proven that it is impossible to obtain a real picture of the dynamics of changes in their correlative relationships at various stages of the prenatal period of human ontogenesis. Therefore, in order to study the features of the external and internal topography, the dynamics of the formation and the syntopy of internal male genital organs at different stages of prenatal development of man, we consider it expedient to apply the method of making plastic reconstructions of not a single organ, but a complex of adjacent organs and structures of the pelvic cavity to obtain objective result on their mutual location in the process of growth and formation. We have developed a method for making plastic reconstructions of organs and structures of the pelvic cavity in the prenatal period of human ontogenesis<sup>14</sup>, as well as a device for making plastic reconstructions<sup>15</sup>. The spatial-temporal organization of the SV, the seminal and the ejaculatory ducts are studied, their position relative to the frontal, sagittal and horizontal planes is taken into account at a given period of development, we also try to coordinate the reconstruction plane with the position plane of the object. Such a methodological approach provides a morphological study of the true facts.

After a careful study of a series of histological sections under a microscope, the number of slices for the sketch is calculated and the question of increasing the contours of the object under study, which will be used in the sketch and making the reconstruction is settled. The specimens are sketched with a microprojection device. After that the contours of the sections of this object are applied to the wax plates taking into account the guiding reference points for comparison of the slice models. The model of each specimen is cut with the lancet by its contours.

When making wax models of slices, it is necessary to correctly approximate them, preserving the strength of the models of individual structures. For this purpose, parts of the organ, are fixed with metal studs, poked into the thickness of the model. Then, the relief of the surface of the model is smoothed taking into account the features of the contours of the organ and its components.

## RESULTS

In pre-fetuses of 46.0-52.0 mm PCL, the mesonephric duct (wolffian duct) is reduced in the cranial and middle sections. The diameter of the unreduced portion of the wolffian duct at the gonad level varies from 58 to 68  $\mu\text{m}$ . The lumen of the mesonephric

ducts is lined with a single-row cubic epithelium, in which cytoplasmic branching directed into the lumen of the ducts are displayed. In the caudal section of the mesonephric duct from the outside, a circular layer of mesenchyme cells with oval-shaped nuclei is determined. Structural rearrangements in the wall of the caudal section of the mesonephric duct should be considered as the formation of the seminal duct.

A microscopic study of pre-fetal sections of 65.0-75.0 mm PCL revealed the onset of the formation of glandular elements of the prostate, arising from the proliferation of the epithelium of the prostate of the male urethra.

At the beginning of the fetal period of ontogenesis, the length of the right seminal vesicle is  $1.56 \pm 0.12$  mm, its width is  $0.54 \pm 0.05$  mm, its thickness is  $0.46 \pm 0.06$  mm. The dimensions of the left seminal vesicle are accordingly:  $1.39 \pm 0.11$ ,  $0.61 \pm 0.05$  and  $0.57 \pm 0.06$  mm.

In fetus of 85.0-95.0 mm PCL, the right SV length is 0.8 mm and the length of its cavity reaches 1.8 mm. The length of the left SV is 1.0 mm, and the length of its cavity reaches 1.7 mm. Thus, the length of the cavity of both the right and left SV exceeds their length by an average of 2 times.

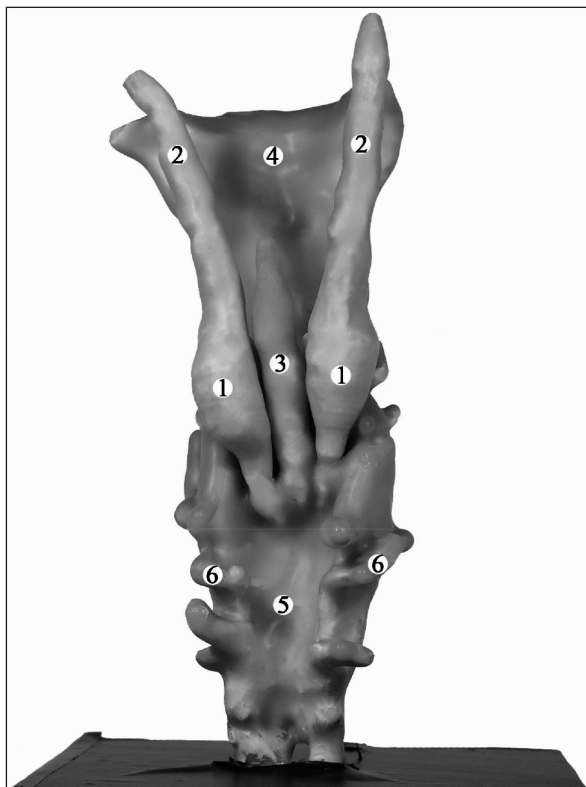
At the end of the 4<sup>th</sup> month of prenatal development (fetuses of 125,0-135,0 mm PCL), the external and internal structure of the seminal vesicles and ampullae of the seminal duct becomes more complicated.

In fetus of 130.0 mm PCL, the SV are represented by the main tubule and its branches. The length of the right SV is 2.3 mm, and the left is 2.2 mm. The length of the cavity of the main duct of the right SV is 4.6 mm, and 6.4 mm including the branches. The length of the cavity of the main duct of the left SV is 4.8 mm, and 5.6 mm including the branches.

## DISCUSSION

On the basis of our study, it is established that in human pre-fetuses of 54.0-66.0 mm PCL, the cavity of the mesonephric or wolffian ducts at the level of the neck of the bladder widens spindle-like, which can be considered the beginning of the SV anlage (Fig. 1). In the subsequent stages of embryogenesis, the widening of the cavity of the wolffian ducts occurs predominantly in the dorsolateral direction and at the end of the third month of prenatal development it turns into a hollow tubule, 4.0-5.0 mm in length.

At the beginning of the fetal period of ontogenesis, the SV diverges laterally from the seminal ducts and is represented by the main tubules 400-420  $\mu\text{m}$

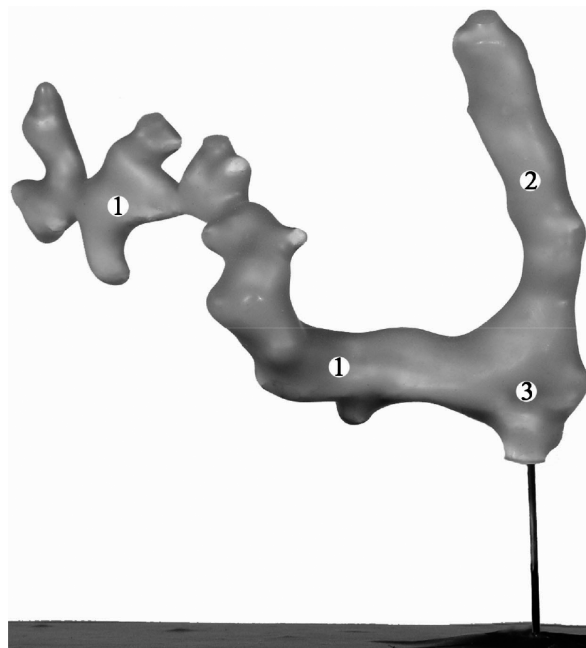


**Fig. 1.** Reconstruction of cavities and internal structures of the complex of pelvic organs of pre-fetus 65.0 mm PCL. Posterior view. Wax model. Scaling x 50.

- 1 – anlage of the seminal vesicle; 2 – mesonephric duct;
- 3 – paramesonephric duct; 4 – bladder;
- 5 – the prostate part of the male urethra;
- 6 – anlage of the excretory ducts of the prostate

in diameter, with minor branches and protrusions (Fig. 2). Due to protrusions and branches of the main tubule, a barely perceptible nodulation is observed on the surfaces of the SV. The internal relief of the cavity wall of the seminal duct is lined with a double-layered cylindrical, and in some places two-layered cubic epithelium, around which circularly oriented 5-6 layers of mesenchyme cells are arranged with spindle-shaped and elongated cores and connective tissue fibers. The diameter of the lumen of the seminal duct varies from 48 to 64  $\mu\text{m}$ .

On the basis of the study of a series of histological specimens of the fetus of 85.0-95.0 mm PCL and the reconstructions made from them, it is established that the right SV is first laterally oriented, and then it forms a bend and is directed forward and laterally. It should be noted that the cavity of the SV forms more complex bends than the bubble itself. The initial section of the cavity of the right seminal vesicle first forms an arc convex, facing laterally, further dorsal, and then ventrolaterally and somewhat cranially (Fig. 3A).



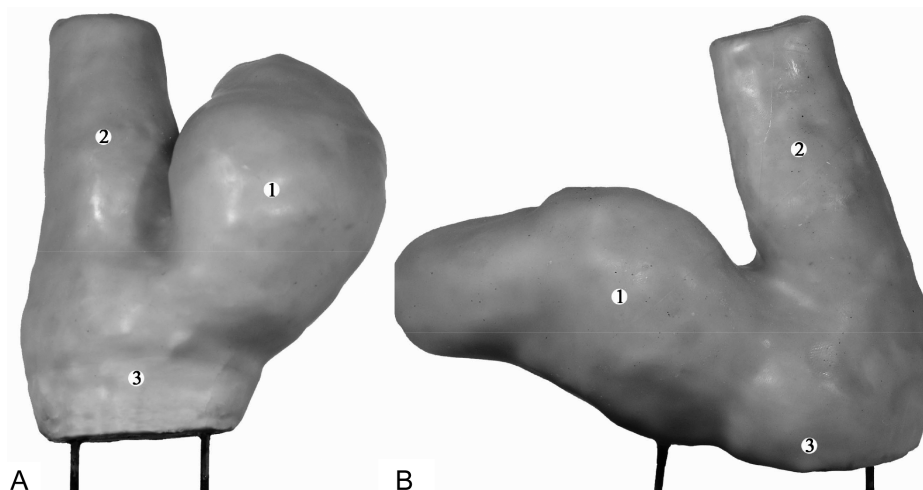
**Fig. 2.** Reconstruction of the right seminal vesicle and adjacent structures of the fetus 82.0 mm PCL. Anterior view. Wax model. Scaling x 60.

- 1 – seminal vesicle; 2 – seminal duct; 3 – ejaculatory duct

The left seminal vesicle extends laterally from the seminal duct, forms a slight bend and is directed forward and laterally. The initial section of the cavity of the left seminal vesicle is located laterally, then turns dorsocranially and laterally almost at right angle (Fig. 3 B).

In fetuses of 95.0-120.0 mm PCL, the distal part of the seminal duct before connecting with SV thickens and forms a slight bend. In this case, the cavity of the distal part of the seminal duct becomes more than twice as large as its proximal part, which should be considered as the beginning of the formation of the seminal duct. The described extensions of the seminal duct slightly exceed the transverse dimension of SV (Fig. 4). The cavity of the seminal duct does not form branches characteristic of SV.

It should be noted that in the part of the mesonephric duct that is placed caudally beyond SV, in the seminal duct, there are no significant changes compared to SV and seminal duct. Due to the connection of the seminal duct with SV, the ejaculatory duct is formed. Having formed, the right and left ejaculatory ducts are directed parallel downward and enter through the posterior surface of the prostate gland into its thickness. In the caudal direction the ejaculatory ducts sink deeper into the parenchyma of the prostate gland, and then follow a few anteriorly and open on the posterior wall of the prostatic part of the urethra on the sides of the tip of the seminal vesicle.



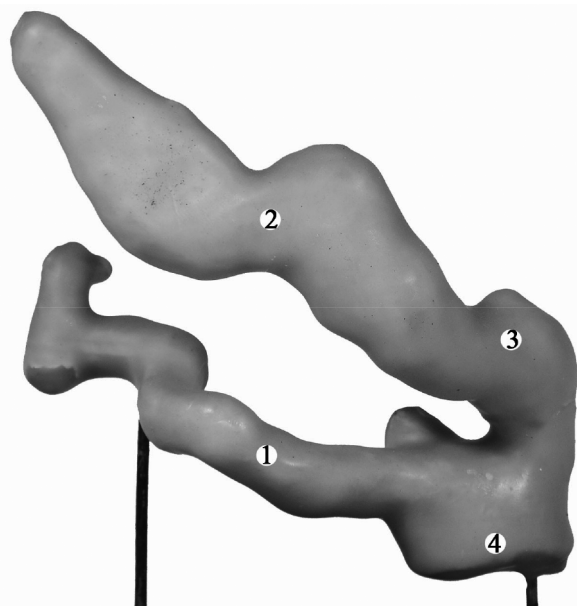
**Fig. 3.** Reconstruction of the right (A) and left (B) seminal vesicles and adjacent structures of the fetus of 85.0 mm PCL. Posterior view. Wax model. Scaling x 80.

1 – seminal vesicle; 2 – seminal duct; 3 – the ejaculatory duct.

It should be noted that in the early stages of embryogenesis the caudal ends of the paramesonephric ducts connected in one stroke pass between the ejaculatory ducts and in front of them, and the prostatic utricle forms in the subsequent stages.

As one can be seen from the reconstructions made by us, in fetus 130.0 mm PCL the right SV is placed horizontally, and its apex is directed cranially. The right SV in the form of a tubular formation is lateral from the seminal duct, forms a bend in the dorsal direction, after which it is directed ventrally. The walls of the protrusions of the SV fit tightly to each other, which gives the impression of a dorsally directed unified formation in the form of SV with insignificant pouches on the external surface of the organ. In general, SV is directed dorsolaterally, and is represented by a major tubule with the largest diameter of the lumen and its branches of different lengths and with smaller diameters. The length of individual sections between the bends of SV is 0.6-0.9 mm.

The final section of the tube gives a branch 1.1 mm long, pointing upwards, which is directed laterally at almost a right angle (Fig. 5A). In addition to the described bends, the right SV forms several less pronounced bends and bulges, which cause the formation of eminence on its surface. The main duct, with the exception of the distal part, is flattened in the dorsoventral direction. Its diameter varies within the range of 0.6-0.8 mm. The cavity of the right SV, basically, repeats the shape of the main tubule, while in some places the branches of the cavity are well expressed, they are located in the thickness of its wall. The first branch is 1.8 mm long, appears at the base of the main duct, and is directed upward and laterally. The initial section of the cavity of SV, 0.9



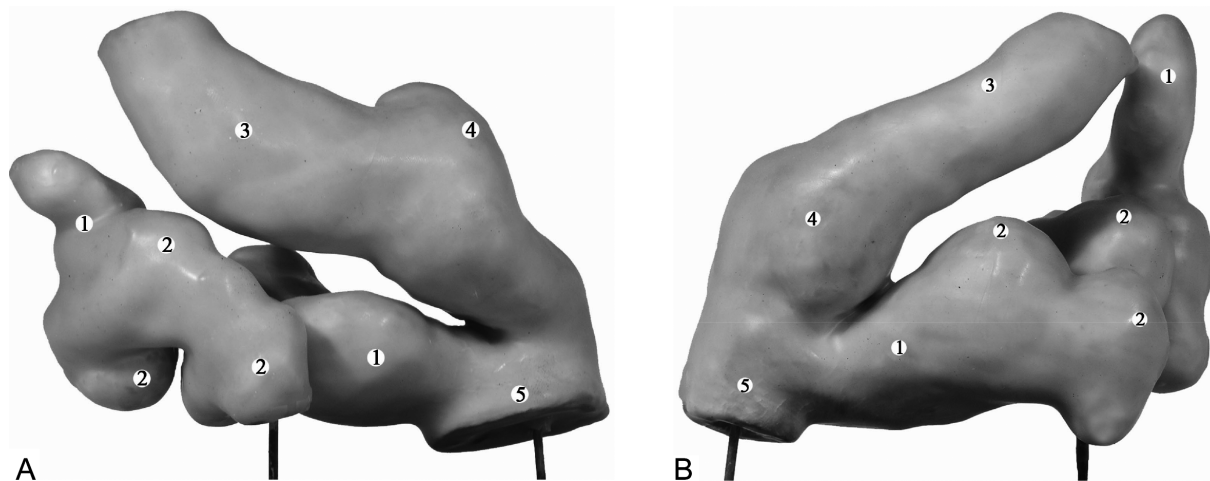
**Fig. 4.** Reconstruction of the right seminal vesicle and adjacent structures of the fetus 95.0 mm PCL. Anterior view. Wax model. Scaling x 70.

1 – seminal vesicle; 2 – seminal duct;

3 – ampulla of the seminal duct; 4 – ejaculatory duct.

mm long, is placed horizontally and directed laterally. After this, the cavity of the SV forms a bend and is directed at a right angle dorsocranially. The length of this part is 0.7 mm. Then the cavity of SV passes laterally and posteriorly, forms a bend and passes at a right angle ventrocaudally. From the upper surface of the described bend a branch of a cavity with a diameter of 0.15 mm springs, which first goes to the front, then at a right angle turns dorsomedially. The length of this part of the branch is 0.2 mm and the





**Fig. 5.** Reconstruction of the right (A) and left (B) seminal vesicles and adjacent structures of the fetus 130.0 mm PCL. Anterior view. Wax model. Scaling x 50.

1 – seminal vesicle; 2 – bends of the seminal vesicle; 3 – seminal duct;  
4 – ampulla of the seminal duct; 5 – the ejaculatory duct

diameter is 70  $\mu\text{m}$ . The next branch is 0.2 mm in length and 0.1 mm in diameter, growing away from the back surface of the bend. The length of the SV cavity after the bend is 0.8 mm. Further the cavity of SV is directed laterally and posteriorly and gives two more branches, one of which extends posteriorly, forms a bend directed downwards, after which it goes medially and forward. The second branch springs cranially, turns posteriorly, upwards and laterally. Note that in the proximal part, the transverse dimensions of which are 0.2 and 0.15 mm, the cavity of the right SV is somewhat flattened in the craniocaudal direction. In the distal direction, the cavity of SV gradually narrows, while its transverse dimensions are 0.14 x 0.1 mm. In addition to minor extensions in individual locations, the SV cavity gives six branches that are, with the exception of one, in the areas of bends. Four branches point upwards, one goes forward and one goes backward. The length of the branches varies from 0.2 to 1.0 mm.

The left SV in the form of a tube passes laterally from the seminal duct, forms a slight bend and is directed ventrolaterally. The length of this part is 1.7 mm. Then the SV forms eight bends in different directions. The main tube of the SV is directed upwards. Taking into account that the cavity of the left SV repeats the shape of the main tubule and its branches, forms distinct bends, its transverse dimensions are not the same in length. The initial section of the cavity of the SV, which goes from the seminal duct dorsolaterally, is directed ventrolaterally. The length of this part is 1.3 mm. The cavity of the left SV in this part is somewhat flattened in the craniocaudal direction, its transverse dimension is 0.3 x 0.21 mm. Further, the cavity of the SV acquires a

cylindrical shape with a diameter of 0.15 mm and is directed dorsolaterally, after which it forms a bend upwards and medially, and then downwards and laterally, slightly curving, follows craniocaudal direction. From the cavity of the SV there are four branches. The largest branch, which starts from the terminal section of the enlarged part of the main tubule of the SV, is directed craniomedially. The length of this branch is 0.27 mm, and the transverse diameter is 0.18 mm. Other branches deviate from the cavity of the SV in points of bends. One branch is directed down, the second up and the third branch up and laterally (Fig. 5 B).

It should be noted that in fetus of 130.0 mm PCL the right SV differs from the left SV in the direction and diameter of the tube and in the number and direction of the bends and branches of the main organ tube. In particular, the right SV forms less bends than the left SV, however they are larger in size than in the latter.

## CONCLUSIONS

1. At the end of the 10<sup>th</sup> and the beginning of the 11<sup>th</sup> week of prenatal development, the intensive development of the caudal parts of the mesonephric ducts is noted, manifested in the structural changes in their walls, as a result of which the seminal ducts, seminal vesicles and excretory ducts of the prostate gland appear.
2. In the fetuses of 95.0-120.0 mm PCL, formation of an ampulla of the seminal duct is observed.
3. In 4-month-old fetuses, the length of the cavity of seminal vesicles exceeds their length by an average of 2 times.

4. At the end of the 4<sup>th</sup> month of prenatal development (fetuses of 125.0-135.0 mm PCL), the external and internal structure of the seminal vesicles and ampulla of the seminal duct become more complicated.

This study on the timing of the anlage and structural organization of the seminal vesicles, the seminal ducts and the ejaculatory ducts in the prenatal period of 10-12 weeks and the fetuses of 4 months indicates the need to further investigate the features of the formation of their structure in the fetuses of 5-10 months and newborns.

#### Compliance with Ethics Requirements:

„The authors declare no conflict of interest regarding this article“

„The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national law. Informed consent was obtained from all the patients included in the study“

The commission on biomedical ethics of the Bukovina State Medical University has not revealed violations of moral and legal rules in the conduct of this medical scientific research.

#### REFERENCES

- Danilova TI, Tikhomirova VYu, Melnikova EA, et al. Undescended testis and the modern approach to prophylaxis of male infertility. *Pacific Medical Journal* 2006;(4): 59-60. in Russian.
- Tavokina LV. Male infertility: genetic aspects. *Kidneys* 2014; 2(8): 9-13. in Russian.
- Yu YD, Hong YK. A case of cryptorchidism with ipsilateral congenital unilateral absence of the vas deferens and contralateral renal agenesis. *Case Rep Urol* 2016; 2016: article ID 2379793.
- Mawhinney M, Mariotti A. Physiology, pathology and pharmacology of the male reproductive system. *Periodontol* 2013; 61(1): 232-251.
- Weiske W-H, Sälzler N, Schroeder-Printzen I, Weidner W. Clinical findings in congenital absence of the vasa deferentia. *Andrologia* 2000; 32(1): 13-18.
- Calleja Escudero J, Telleria Orriols JJ, Estebanez Zarranz J, et al. Agenesis of vas deferens and cystic fibrosis. *Actas Urol Esp* 1997; 21: 773-776.
- Mutovin GR, Ivanova OG, Zhilina SS. Genes and ontogeny of the reproductive system. *Pediatrics Journal* 2009; 88(6): 40-47. in Russian.
- Khan ZAJ, Novell JR. A missing vas. *Journal of the Royal Society of Medicine* 2001; 94(11): 582-583.
- Akira M, Yoshiyuki S. Placental circulation, fetal growth, and stiffness of the abdominal aorta in newborn infants. *J Pediatr* 2006; 148(1): 49-53.
- Ertan AK, He JP, Hendrik HJ, et al. Reverse flow in fetal vessels and perinatal events. *Z Geburtshilfe Neonatol* 2004; 208(4): 141-149.
- Louey S, Cock ML, Stevenson KM, et al. Placental insufficiency and fetal growth restriction lead to postnatal hypotension and altered postnatal growth in sheep. *Pediatr Res* 2000; 48 (66): 808-814.
- Schlegel PN, Shin D, Goldstein M. Urogenital anomalies in men with congenital absence of the vas deferens. *Journal of Urology*. 1996; 155(5): 1644-1648.
- Loitra AO, Marchuk FD, Khmara TV. Vykorystannia metoda plastychnoho rekonstruiuvannia dlia vyvchennia topografo-anatomichnykh vidnoshen orhaniv u prenatalnomu periodi ontogenezu liudyny. *Ukr. med. almanakh* 2000; 3(6): 122-124. in Ukrainian
- Pishak VP, Khmara TV, Kozub MM. Patent na korysnu model N° 19645 Ukraina, MPK G09B 23/28. Sposib vyhotovlennia plastychnykh rekonstruktsii orhaniv i struktur porozhnyny taza v prenatalnomu periodi ontogenezu liudyny. N° u 2006 08141; Zaiavka 20.07.2006. Opubl. 15.12.2006. Biul. N° 12. in Ukrainian
- Marchuk VF, Khmara TV, Riabyi SI, Marchuk FD. Dekl. patent na vynakhid N° 59127 A Ukraina, MPK G01N1/28. Prystrii dlia vyhotovlennia plastyknovykh plastychnykh rekonstruktsii. N° 2003021088; Zaiavl. 06.02.2003. Opubl. 15.08.2003. Biul. N° 8. S. 126. in Ukrainian.