

### Anatomical and Topographic Characteristics of the Prostate Gland of Rats during Postnatal Ontogenesis

**Radjabov Akhtam Boltaevich**

Doctoral Candidate (DSc), Bukhara State Medical Institute

#### Article Information

**Received:** December 05, 2022

**Accepted:** January 06, 2023

**Published:** February 07, 2023

**Keywords:** *rat prostate, postnatal ontogenesis, organometric parameters, prostate mass.*

#### ABSTRACT

The article highlights the anatomical and topographic features of the prostate of male rats, their organometric indicators throughout postnatal ontogenesis. Based on the data obtained, the holotoopy of the organ, its shape, the growth rate of the mass of the prostate gland and the anatomical parameters of the prostate of rats (mass, thickness, width, length) were established.

Structural age-related restructuring of the prostate is uneven and manifests itself in a change in the shape and linear parameters of the organ, which is due to the morphological and functional characteristics of the organ in different age periods. It has been established that the greatest increase in the weight of the prostate is observed in the interval from 3 to 9 months, the smallest - in 18-month-old rats. The greatest increase in the linear parameters of the organ was noted by the end of the lactation period and in young rats of 6 and 9 months of age.

**Introduction.** The study of the regularities of the morphofunctional state of the mammalian reproductive system is one of the urgent problems of modern medicine, since it is the basis for clarifying the etiology, pathogenesis, diagnosis and ways of their treatment with diseases of the reproductive system [7,9].

Studies on the age-related restructuring of the internal organs of mammals, both at the macroscopic and microscopic levels, do not lose their relevance. From the point of view of pathomorphology, age-related changes are of interest in terms of adjusting the age norm and taking it into account when assessing pathological processes [1,2].

Since the emergence and development of the pathological process in the prostate depends on the structural and functional parameters of the organ [5,11,12,13,14,15], it is of undoubted interest to study the development and formation of the anatomical parameters of the prostate in the age aspect. This is of fundamental importance in understanding the problems of mammalian ontogeny.

It should be noted that in the presented scientific literature there are no comprehensive studies concerning the patterns of formation of biometric parameters of the prostate throughout the postnatal ontogenesis.

**Purpose of the study:** To establish patterns of development and formation of macroanatomy of the rat prostate throughout the entire postnatal ontogenesis.

**Material and methods of research:** The object of the study was 161 outbred male rats from the neonatal period to 18 months. The terms of the study of rats in the period of milk feeding were chosen on the basis of the age periodization of laboratory animals [3] and were based on the data of their physical development. Along with this, the age gradation of laboratory animals, in

particular rats [6], was applied, according to which the age of rats in late postnatal ontogenesis was distributed as follows:

- 1-month-old animals - infantile or immature age;
- 3 - menstruation - juvenile age;
- 6 - 9 - monthly - young animals;
- 12 - monthly - mature or adult animals;
- 18 - monthly - old animals.

All stages of the study were carried out in compliance with the European Convention for the Protection of Vertebrate Animals used for Experimental or other Scientific Purposes (Directive 2010/63/EU).

All groups were formed at the same time. The laboratory animals participating in the experiment were representative in terms of age, weight, housing and feeding conditions.

An experimental preclinical study of laboratory animals was carried out on the basis of the official letter of the Ethics Committee of the Ministry of Health of the Republic of Uzbekistan No. 5 / 15-1682 dated July 5, 2022 on the permission to conduct these studies (extract from the protocol No. 5 of the meeting of the ethical committee M3 of the Republic of Uzbekistan dated July 1, 2022).

Rats were taken out of the experiment by instantaneous decapitation under ether anesthesia according to the rules approved by the relevant documents [4,8,10].

To study the morphometric parameters of the prostate, a macroscopic method (anatomical preparation) was used. Animals were slaughtered on days 6, 11, 16, 21, and at the end of 1, 3, 6, 9, 12, 18 months of life in the morning, on an empty stomach. When killing and autopsy of laboratory animals, the rules of biological safety and ethical principles of working with laboratory animals were observed.

After opening the pelvic cavity, the topography of the organ and its shape were determined, and the mass, length, width, and thickness of the prostate were measured. The prostate mass was measured on a JW-1 electronic scale ( $e = 0.02$  g) from Acom Inc. (South Korea), lengths, widths and thicknesses - with a ruler or millimeter tape.

Mathematical processing of the morphometric data obtained during the study was carried out directly from the general matrix of the Microsoft Office data package "Excel 7.0" on a personal computer Pentium-IV using the capabilities of the "STTGRAPH 5.1" program to determine the standard deviation and representativeness errors.

When organizing and conducting research, the principles of evidence-based medicine were observed.

**Research results:** It has been established that in rats of the lactation period up to 21 days, the prostate is located in the pelvic cavity above the upper edge of the pubic symphysis, it comes into contact with the bladder from above, covering the urethra from the front, has a brownish-red color and a soft texture. In newborn rat pups and 6-day-old rat pups, it always has an elongated oval shape. On the 11th day of development of rat pups, the iron has an elongated oval (72.2%) and rounded shape (27.8%). In 16-day-old rat pups, the prostate has an elongated-oval (76.5%) and rounded shape (23.5%). By the end of the sucking period, i.e. by day 21, the organ has an elongated oval (87.5%) and rounded shape (12.5%). In infantile (1-month-old) and juvenile (3-month-old) rat pups, the prostate gland is located in the pelvic cavity under the bladder, from behind it comes into contact with the anterior surface of the pubic symphysis, behind which the

rectum is located. In monthly rat pups, the iron has an elongated-oval (78.6%) and rounded shape (21.4%). At the 3rd month of development, the prostate has an elongated-oval (83.3%) and rounded shape (16.7%).

In young animals 6 months of age, the prostate gland is characterized by a two-lobed (78.6%) or four-lobed (21.4%) structure. At the age of 9 months, a two-lobed structure is observed in 16.7% of cases, a four-lobed structure - in 83.3% of cases. With a two-lobed structure, both lobes have an oblong oval shape. The gland, being under the bladder, covers the proximal end of the vas deferens and is located along the lateral wall of the urethra. The size of the gland is larger than the empty bladder.

At the age of one and a half years, the prostate has a four-lobed structure. The ventral lobe consists of two oval-shaped lobes located ventrolateral to the bladder and attached to the urethra by connective tissue. The dorsal and lateral lobes, commonly referred to as the dorsolateral prostate, run along the urethra. The dorsolateral lobe is located behind the bladder and the beginning of the seminal vesicles, its posterior surface is adjacent to the descending colon. Both lobes are located above the upper edge of the pubic joint. The anterior lobes (coagulation gland) are thin, tubular, oblong structures attached along the lesser curvature of the seminal vesicles.

Weight indicators and linear parameters of the prostate are presented in the table. It has been established that the mass of the prostate gland in rats at birth ranges from 0.05 to 0.10 grams, with an average of  $0.08 \pm 0.003$  grams. On the 6th day of development, the weight of the prostate is in the range of 0.08-0.12 grams, on average  $0.10 \pm 0.002$ . The growth rate is 25.0%. In 11 day old rat pups, the weight of the prostate varies from 0.09 to 0.15 grams, with an average of  $0.13 \pm 0.004$  grams. The organ mass growth rate is 30.0%. On the 16th day of development, the mass of the prostate ranges from 0.11-0.17 grams, on average it is  $0.15 \pm 0.004$  grams. The growth rate is 15.4%. By the end of the suction period (21 days), the weight of the prostate gland is in the range of 0.16-0.22 grams, on average  $0.19 \pm 0.004$  grams. The growth rate is 26.7%. In rats of infantile age (1 month), the mass of the prostate varies from 0.17 to 0.28 grams, with an average of  $0.24 \pm 0.009$  grams. The organ mass growth rate is 26.3%. At the 3rd month of development, i.e. in juvenile age, the weight of the prostate ranges from 0.26-0.39 grams, on average -  $0.34 \pm 0.001$  grams. The growth rate is 41.7%. In young 6-month-old rats, the mass of the prostate gland ranges from 0.31 to 0.83 grams, averaging  $0.60 \pm 0.04$  grams. The growth rate is 76.5%. At the 9th month of development, the weight of the prostate varies from 0.66 to 1.09 grams, with an

**Table. Age-related organometric parameters of the rat prostate during postnatal ontogenesis**

parameter age	number of animals	Prostate			
		organ weight (gr)	thickness (mm)	width (mm)	length (mm)
newborns	18	0,08±0,003	1,5±0,07	2,17±0,07	3,7±0,07
6 days	20	0,10±0,002*	1,9±0,06*	2,5±0,06	4,5±0,06*
11 days	18	0,13±0,004*	2,3±0,07*	3,1±0,13*	5,3±0,13*
16 days	17	0,15±0,004	2,8±0,14	3,5±0,07	6,3±0,14*
21 days	16	0,19±0,004*	3,6±0,15	4,6±0,15*	7,9±0,15*
1 month	14	0,24±0,009*	4,3±0,08*	5,3±0,25	9,0±0,16*
3 months	12	0,34±0,01*	5,0±0,18	6,2±0,18	10,1±0,28
6 months	14	0,60±0,04*	6,7±0,25*	8,9±0,25*	13,0±0,41*
9 months	12	0,91±0,04*	7,5±0,18	15,0±0,55*	14,1±0,46
12 months	10	1,12±0,05	7,9±0,32	16,1±0,43	15,2±0,43
18 months	10	1,23±0,07	8,4±,32	17,4±0,43	16,1±0,43

Note: \* - reliability of differences in relation to previous age

average of  $0.91 \pm 0.04$  grams. The organ mass growth rate is 51.7%. By the 1st year of life, the weight of the organ ranges from 0.86 to 1.34 grams, with an average of  $1.12 \pm 0.05$  grams. The growth rate is 23.1%. At the age of one and a half years, the mass of the prostate is in the range from 0.96 to 1.65 grams, on average it is  $1.23 \pm 0.07$ . The growth rate is 9.8%.

The study showed that the thickness of the prostate gland in newborn rat pups varies within 1-2 mm, averaging  $1.5 \pm 0.07$  mm. On the 6th day of development, the thickness also fluctuates within 1-2 mm, averaging  $1.9 \pm 0.06$  mm. The thickness growth rate is 26.7%. By the 11th day, the thickness of the organ is in the range of 2-3 mm, averaging  $2.3 \pm 0.07$  mm. The growth rate is 21.1%. On the 16th day of development, the thickness of the prostate varies within 2-4 mm, averaging  $2.8 \pm 0.14$  mm. The growth rate of the organ thickness is 21.7%. By the end of the lactation period (21 days), the thickness of the prostate ranges from 3 to 5 mm, averaging  $3.6 \pm 0.15$  mm. The growth rate is 28.6%. In one-month-old rat pups, the thickness of the prostate gland is 4-5 mm, on average it is  $4.3 \pm 0.08$  mm. The growth rate of the organ thickness is 19.4%. At the 3rd month of development, the thickness of the prostate varies from 4 to 6 mm, averaging  $5.0 \pm 0.18$  mm. In 6-month-old rats, the thickness of the prostate is in the range of 5-8 mm, on average  $6.7 \pm 0.25$  mm. The growth rate is 34.0%. By the 9th month of development, the thickness is 6-8 mm, on average  $7.5 \pm 0.18$  mm. The growth rate is 11.9%. By the end of the 1st year of life, the thickness of the prostate ranges from 6 to 9 mm, averaging  $7.9 \pm 0.32$  mm. The growth rate is 23.1%. In rats at the 18th month of development, the thickness of the prostate gland varies within 7-10 mm, on average it is  $8.4 \pm 0.32$  mm. The growth rate is 9.8%.

It was found that the width of the prostate gland in newborn rat pups is in the range of 2-3 mm, averaging  $2.17 \pm 0.07$  mm. On the 6th day of development, the width of the organ also varies within 2-3 mm, on average it is  $2.5 \pm 0.06$  mm. The growth rate is 15.2%. In 11-day-old rat pups, the width of the prostate ranges from 2 to 4 mm, on average,  $3.1 \pm 0.13$  mm. The growth rate of the organ width is 24.0%. On the 16th day of development, the width of the prostate ranges from 3-4 mm, on average  $3.5 \pm 0.07$  mm. The growth rate is 12.9%. By the end of the sucking period, i.e. by day 21, the width varies from 4 to 6 mm, averaging  $4.6 \pm 0.15$  mm. The growth rate is 31.4%. In one-month-old rat pups, the width of the prostate gland is in the range of 4-7 mm, on average,  $5.3 \pm 0.25$  mm. The growth rate is 15.2%. At the 3rd month of development, the width of the organ ranges from 5 to 7 mm, averaging  $6.2 \pm 0.18$ . The growth rate is 17.0%. In 6-month-old rats, the width of the prostate varies within 7-10 mm, on average it is  $8.9 \pm 0.25$  mm. The growth rate is 43.5%. By the 9th month of development, the width of the prostate is in the range from 12 to 18 mm, on average  $15.0 \pm 0.55$  mm. The growth rate of the organ width is 68.55%. In one-year-old rats, the width of the organ ranges from 14 to 18 mm, on average  $16.1 \pm 0.43$  mm. The growth rate is 7.3%. At the 18th month of development, the width of the prostate varies from 16 to 20 mm, averaging  $17.4 \pm 0.43$  mm. The growth rate is 8.1%.

The study showed that the length of the prostate gland in rat pups at birth is in the range of 3-4 mm, averaging  $3.7 \pm 0.07$  mm. In rat pups on the 6th day of development, the length of the prostate varies within 4-5 mm, on average  $4.6 \pm 0.06$  mm. The growth rate is 22.6%. On the 16th day of development of rat pups, the length of the prostate gland varies from 5 to 7 mm, on average it is  $6.3 \pm 0.14$  mm. The growth rate of the organ length is 18.9%. By the end of the suction period, the length of the organ is in the range of 7-9 mm, on average  $7.9 \pm 0.15$  mm. The growth rate is 25.4%. In monthly rat pups, the length of the prostate varies from 8 to 10 mm, on average  $9.0 \pm 0.16$  mm. The length growth rate is 13.9%. At the 3rd month of development, the length of the organ varies from 8 to 11 mm. On average, it is  $10.1 \pm 0.28$  mm. The growth rate is 12.1%. In 6-month-old rats, the length of the prostate gland ranges from 10 to 15 mm, on average  $13.0 \pm 0.41$  mm. The growth rate is 28.7%. At the 9th month of development, the length of the prostate ranges from 11 to 16 mm, averaging  $14.1 \pm 0.46$  mm. The growth rate is 8.5%. In 12-month-old rats, the length of the prostate varies from 13 to 17 mm, on average,  $15.2 \pm 0.43$

mm. The growth rate is 7.8%. At the 18th month of development, the length of the prostate gland ranges from 14 to 18 mm, on average  $16.1 \pm 0.43$  mm. The growth rate of the organ length is 5.9%.

### **Conclusions:**

1. The use of a complex of macroscopic and morphometric methods for studying the prostate gland makes it possible to identify characteristic features that characterize the features of the dynamics of development and formation of the organ occurring in the process of ontogenesis.
2. Structural age-related restructuring of the prostate is uneven and manifests itself in a change in the shape-linear parameters of the organ, which is due to the morphological and functional characteristics of the organ in different age periods.
3. The weight of the prostate during postnatal ontogenesis varies unequally. Its greatest growth is observed in the interval from 3 to 9 months, the smallest - at the age of one and a half years.
4. At all stages of postnatal ontogenesis, the length of the prostate is always greater than the width and thickness, and from the age of 9 months, the transverse size of the gland begins to prevail over the longitudinal and anterior-posterior dimensions. The greatest increase in these indicators was noted by the end of the suckling period and in young rats 6 and 9 months of age.

### **Literature**

1. Burov V.V. The study of morphological indicators of the female mammary gland in different age periods // *Modern problems of science and education*. - 2014. - No. 1. - S. 137.
2. Efimov A.A. Morphological analysis of age-related changes in the arterial wall. Academician I.P. Pavlova. - 2011. - No. 3. - S. 8-12.
3. Zapadnyuk V.I. To the question of age periodization of laboratory animals // *Aging of the cell*. - Kyiv, 1971. - pp. 433-438.
4. Koptyaeva K.E., Muzhikyan A.A., Gushchin Ya.A., Belyaeva E.V., Makarova M.N., Makarov V.G. Method of autopsy and extraction of organs of laboratory animals // *Message 1: rat. Laboratory animals for scientific research*. - 2018. - No. 2. - C. 71-92. DOI: 10.29296/10.29296/2618723X-2018-02-08.
5. Kudryavtsev Yu.V., Sivkov A.V. Morphological changes in the prostate tissue in benign hyperplasia // *Experimental and clinical urology*. - 2010. - No. 1. - S. 18–22.
6. Makarov V.G., Makarova M.N. Physiological, biochemical and biometric indicators of the norm of experimental animals. St. Petersburg: Publishing house "LEMA", 2013.- 116 p.
7. Mukhotrofimova O.M. Comparative morphofunctional characteristics of the reproductive organs of some rodent species (RODENTIA). Abstract of the dissertation for the degree of Candidate of Biological Sciences. Moscow, 2010, 21s.
8. Rybakova A.V. Methods of euthanasia of laboratory animals in accordance with the European Directive 2010/63 / A.V. Rybakova, M.N. Makarova // *International Veterinary Bulletin*. - 2015. - No. 2. - S. 96-107.

9. Savelyeva A.Yu. Workshop on the anatomy of decorative and exotic animals [Electronic resource] / A.Yu. Saveliev; Krasnoyar. state agrarian un-t. - Krasnoyarsk, 2018. - 284 p.
10. Sidorov P.I. The use of laboratory animals in a toxicological experiment: guidelines. - Arkhangelsk. - 2002. -15 p.
11. Trotsenko B.V. Regional heterogeneity of the mesenchyme in the processes of prostate morphogenesis in human fetuses and rats / B.V. Trotsenko, I.A. Lugin // *Morphology*. - 2009 V.3 - No. 3. - P.126-130.
12. Knoblauch S., Tretiakova M., Hukkanen R. Male reproductive system. In *Comparative Anatomy and Histology: A Mouse, Rat and Human Atlas*; Treuting, P., Dintzis, S., Montine, K., Eds.; Academic Press: Cambridge, MA, USA, 2017; pp. 335–338.
13. Linda M. Ernest Color Atlas of fetal and neonatal histology / M. Ernest Linda, Eduardo D. Ruchelli, Dale S. Huff // Springer. 2011. 399p.
14. Nickel J. C. Clinical evaluation of the patients pressing with prostatitis // *Europ. Urol.* - 2003. - Vol.2. – P. 11-14.
15. Whitney K. Male accessory sex glands. In *Boorman's Pathology of the Rat: Reference and Atlas*; Suttie A., Leininger J., Bradley A., Eds.; Academic Press - Elsevier: Cambridge, MA, USA, 2018; pp. 579–586.