



MORPHOMETRIC CHANGES IN THE HISTOLOGICAL STRUCTURE OF THE UTERINE BODY DURING POSTNATAL ONTOGENESIS IN GOATS

Mallayev Muhridin G'ofur o'g'li

Termiz davlat muhandislik va agrotexnologiyalar universiteti

Zooinjeneriya, veterinariya va ipakchilik kafedrası assistenti, v.f.f.d. (PhD)

Tangirov Kayum Jurayevich

Termiz davlat muhandislik va agrotexnologiyalar universiteti

Zooinjeneriya, veterinariya va ipakchilik kafedrası professori vazifasini

bajaruvchi, veterinariya fanlari nomzodi

Abstract: This article investigates the histological structure of the uterine body wall and its age-related morphometric changes during postnatal ontogenesis in goats. The results showed that the perimetrium, myometrium, and endometrium layers of the uterine wall gradually increased in thickness throughout postnatal development. From 3 days to 60 months of age, the perimetrium increased 11.85-fold, the myometrium 3.90-fold, and the endometrium 2.69-fold. The findings demonstrate the age-related differential development of the histological structures of the goat uterus during postnatal ontogenesis.

Keywords: Goat, postnatal ontogenesis, morphometric parameters, growth coefficient, absolute value, uterine body.

Introduction

Goats are considered one of the first wild animals to have been domesticated by humans. At present, goats are raised throughout the world, from the northern latitudes of Scandinavia to the tropics of Africa and the islands of Oceania.



In order to develop the livestock sector in the Republic, highly productive dairy goat breeds such as Saanen, Alpine, and Toggenburg have been imported from developed European countries, and their breeding has been established. It is of great importance to raise imported dairy goat breeds under the climatic conditions of our country, conduct breeding programs, and develop appropriate feeding technologies. Therefore, the development of scientifically based recommendations is considered one of the important priority tasks.

The morphology of the reproductive system of goats is primarily characterized by age-related differences in the histomorphological features of the reproductive organs at different stages of the reproductive cycle. Considering the productive characteristics of goats and environmental conditions, the study of their reproductive organs is undoubtedly relevant.

According to the authors, the uterus is located in the abdominal cavity and is supported by the broad uterine ligaments. The broad ligaments of the uterus consist of a double fold of the peritoneum extending from the ovaries, oviducts, and mesometrial part of the uterus to the region of the lumbar or pelvic vertebrae. In carnivorous animals, the uterus is supported by broad and round ligaments. The round ligaments have a cord-like structure, originate from the cranial part of the uterine horns, and extend toward the internal opening of the pelvic canal. Researchers have reported that unilateral or bilateral pelvic uterine hernias may develop in female carnivorous animals with a wide pelvic canal, particularly during pregnancy [1, p. 76].

According to Gubarevich Ya.G. (1952), the uterine horns in young sheep are straight, whereas in adult animals they become curved, intestine-like in appearance, with their ends twisted.

According to G.A. Igumnova et al. (1988) and E.A. Tomitova (1998), the endometrium of non-pregnant rabbits is lined with simple columnar epithelium.



The authors note that the uterus of Saanen goats has been sufficiently studied from morphological and anatomical perspectives, and its specific structural features ensure high functional efficiency of the reproductive system. The uterine body is compact and located between the uterine horns and the cervix. The uterine mucosa is characterized by the presence of spiral-shaped transverse folds, which are relatively uniform in number, with their apices directed caudally. These morphological features are of great importance in ensuring the orderly movement of spermatozoa and creating favorable conditions for embryonic development.

The vestibular portion following the cervix also has a certain length, forms the lower part of the reproductive tract, and represents a region that is in direct contact with the external environment. The morphometric parameters of the uterus and its individual parts in Saanen goats are of considerable scientific importance for the comprehensive assessment of the reproductive system of animals of this breed, determination of their degree of anatomical adaptation, and scientifically based analysis of their breeding potential. These morphological data have been reported to serve as one of the main criteria for assessing the physiological condition of animals, hormonal effects, and overall reproductive capacity [3, pp. 41–44].

According to scientific data, the uterine wall consists of three layers: the serous membrane (perimetrium), muscular layer (myometrium), and mucous membrane (endometrium). The serous layer is the visceral layer of the peritoneum and is located on the outer surface of the uterine wall. The middle, or muscular, layer of the uterine body and horns consists of smooth muscle fibers arranged in longitudinal and circular directions, with an intermediate layer rich in blood vessels and nerve fibers located between them. This layer is capable of producing peristaltic contractions of the uterus during parturition and antiperistaltic movements during sexual receptivity and mating. The contractile activity of the uterus is primarily enhanced under the influence of estrogen hormones, whereas progesterone suppresses this process.



The inner layer of the uterine body and horns, the mucous membrane, has a complex structure and is lined with simple columnar epithelium. Numerous tubular glands are located within the thickness of the endometrium, and their excretory ducts open directly into the uterine cavity. These glands are known as endometrial glands and produce a specialized nutritive fluid, uterine milk, which is necessary for the early development of the embryo. Like the myometrium, the endometrium is a target tissue sensitive to sex hormones. Estrogens enhance the blood supply to the endometrium and stimulate glandular proliferation, whereas progesterone increases the functional activity of the tubular glands and enhances the secretion of uterine milk.

During pregnancy, except in marsupials, the placenta develops through the participation of the uterine mucosa and the fetal chorion. In ruminants, placental attachment occurs through specialized caruncles located in the uterine mucosa. Their number may reach 120–140, and they play an important role in the exchange of substances between the mother and fetus [4, pp. 59–66].

Materials and methods. The research was conducted on the reproductive organs of local-breed goats from the “Tog‘aymurodov Burxon” farm in Boysun district and the “Vaxshivor Tepa”, “Bobo-Zangi”, and “Jo‘ra Cho‘pon” farms in Oltinsoy district, Surkhandarya region. Scientific investigations were carried out on the reproductive organs of animals at the following stages of postnatal ontogenesis: 3 days, 3, 6, 12, 18, 36, 48, and 60 months of age.

The study was performed on 40 samples obtained from the reproductive organs of 40 goats. For sampling, animals corresponding to the age groups under study, with the same coat color and constitutional type, clinically healthy and of moderate body condition, were selected. The live body weight of the goats was measured before slaughter.



For examination, the uterus was anatomically dissected, and its length, width, and thickness were measured. The weight was determined using a KEPN 620 g electronic balance with an accuracy of 0.01 mg.

General morphological methods developed and introduced by N.P. Chirvinsky were used for processing the reproductive organs and determining their morphometric parameters. Laboratory analyses were conducted at the Department of Zootecology, Veterinary and Sericulture of the Termiz institute of agrotechnologies and innovative development and at the laboratory of the State center for diagnosis of animal diseases and food safety of Surkhandarya region.

All numerical data obtained from the scientific investigations were mathematically processed according to the method of V.K. Merkurieva.

To determine the age-related dynamics of the thickness of the histological layers of the uterine body in goats, the growth coefficient was calculated. The growth coefficient was determined by dividing the thickness of the corresponding histological layers of the uterine body in older animals by the respective values in younger animals, while the entire studied period of postnatal ontogenesis was determined using the formula developed by K.B. Svechin...

$$K = \frac{V_t}{V_o}$$

K – growth coefficient;

V_t – absolute value of the layers of the uterine body wall in an adult animal;

V_o – initial value of the layers of the uterine body wall.

Mathematical and statistical analysis was performed using Student's t -test and Fisher's test in Microsoft Excel spreadsheet software.

Research Results

The absolute thickness of the perimetrium in the histological structure of the goat uterus was $17.48 \pm 0.678 \mu\text{m}$ during the first 3 days of postnatal development. This parameter increased rapidly up to 3 months of age, reaching $39.62 \pm 1.094 \mu\text{m}$



($K=2.27$; $p<0.03$). At 6 months, the thickness of the perimetrium increased rapidly to $79.12\pm 2.51\ \mu\text{m}$ ($K=2.00$; $p<0.04$), reaching $86.29\pm 2.51\ \mu\text{m}$ at 12 months ($p<0.03$). At 18 months, it increased further to $92.07\pm 2.25\ \mu\text{m}$ ($K=1.07$; $p<0.03$), and at 36 months reached $131.98\pm 2.69\ \mu\text{m}$ ($p<0.02$). At 48 months, the value increased to $167.94\pm 5.36\ \mu\text{m}$ ($K=1.27$; $p<0.03$), while at 60 months it reached the highest level compared with the other age groups, amounting to $207.10\pm 6.72\ \mu\text{m}$ ($K=1.23$). The overall growth coefficient of the absolute value of the uterine body perimetrium from 3 days to 60 months of postnatal ontogenesis was 11.85-fold.

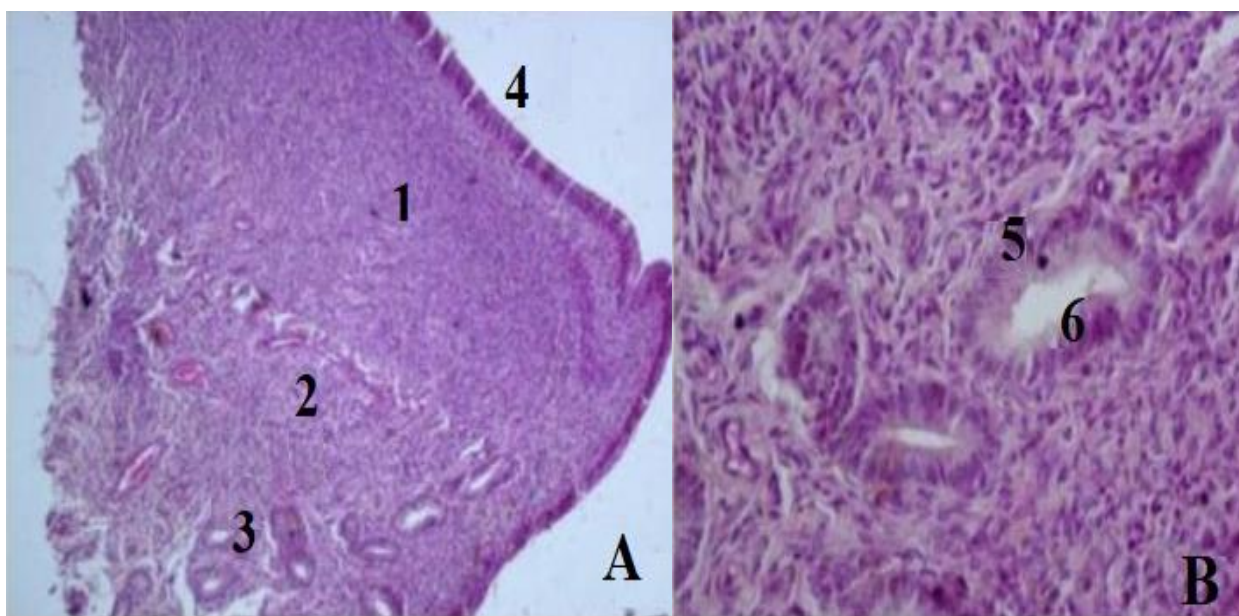
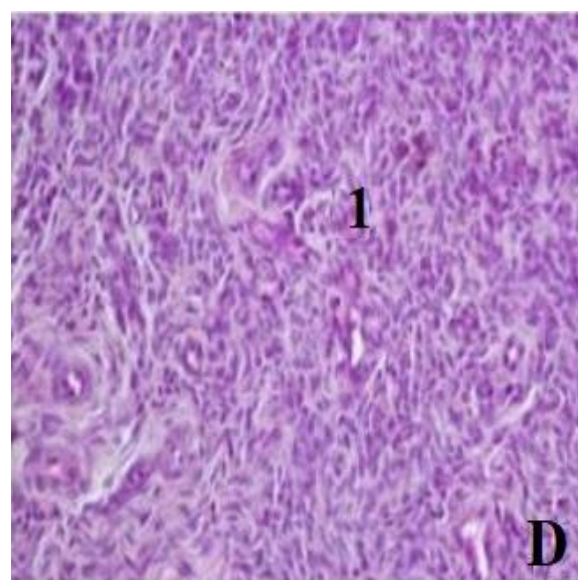


Figure 1. Histological structure of the uterine body of an 18-month-old local-breed goat.

Image A is shown at $10\times$ magnification, while images B and D are shown at $40\times$ magnification. 1 – muscular layer; 2 – endometrial layer; 3 – uterine glands; 4 – basal layer; 5 – secretory cells; 6 – lumen.





The absolute thickness of the myometrium in the histological structure of the uterine body was $65.96 \pm 2.598 \mu\text{m}$ during the first 3 days of postnatal ontogenesis. This parameter increased rapidly up to 3 months of age, reaching a myometrial thickness of $83.55 \pm 2.883 \mu\text{m}$, with a growth coefficient of 1.27-fold during the period from 3 days to 3 months. At 6 months, this parameter increased rapidly to $123.78 \pm 4.45 \mu\text{m}$ ($K=1.48$; $p<0.04$), and at 12 months reached $126.83 \pm 4.78 \mu\text{m}$ ($K=1.02$; $p<0.04$). At 18 months, it increased to $161.67 \pm 5.07 \mu\text{m}$ ($K=1.27$; $p<0.03$). At the subsequent stage, namely 36 months, it reached $185.67 \pm 5.61 \mu\text{m}$ ($p<0.04$). At 48 months, the value increased to $212.79 \pm 7.80 \mu\text{m}$ ($K=1.15$), while at 60 months it reached the highest level compared with the other age groups, amounting to $257.42 \pm 8.01 \mu\text{m}$ ($K=1.21$). The overall growth coefficient of the absolute value of the myometrium of the uterine body from 3 days to 60 months of postnatal ontogenesis was 3.90-fold.

The absolute thickness of the endometrium of the uterine body during postnatal ontogenesis in goats was $71.16 \pm 2.925 \mu\text{m}$ during the first 3 days of postnatal development. This parameter increased rapidly up to 3 months of age, reaching $100.44 \pm 3.920 \mu\text{m}$, with a growth coefficient of 1.41-fold during the period from 3 days to 3 months. At 6 months, the endometrial thickness reached $112.06 \pm 3.70 \mu\text{m}$ ($K=1.12$; $p<0.03$). At the subsequent stage, namely 12 months, it increased to $119.22 \pm 2.69 \mu\text{m}$ ($K=1.06$; $p<0.04$), and at 18 months reached $124.10 \pm 3.94 \mu\text{m}$ ($K=1.04$; $p<0.03$). At 36 months, the value increased to $135.85 \pm 5.26 \mu\text{m}$ ($K=1.09$; $p<0.04$). At 48 months, it reached $167.16 \pm 5.64 \mu\text{m}$ ($K=1.23$), while at 60 months it reached the highest value compared with the other age groups studied, amounting to $191.74 \pm 5.48 \mu\text{m}$ ($K=1.15$). The overall growth coefficient of the absolute thickness of the endometrium of the uterine body from 3 days to 60 months of postnatal ontogenesis was 2.69-fold (Figure 2).

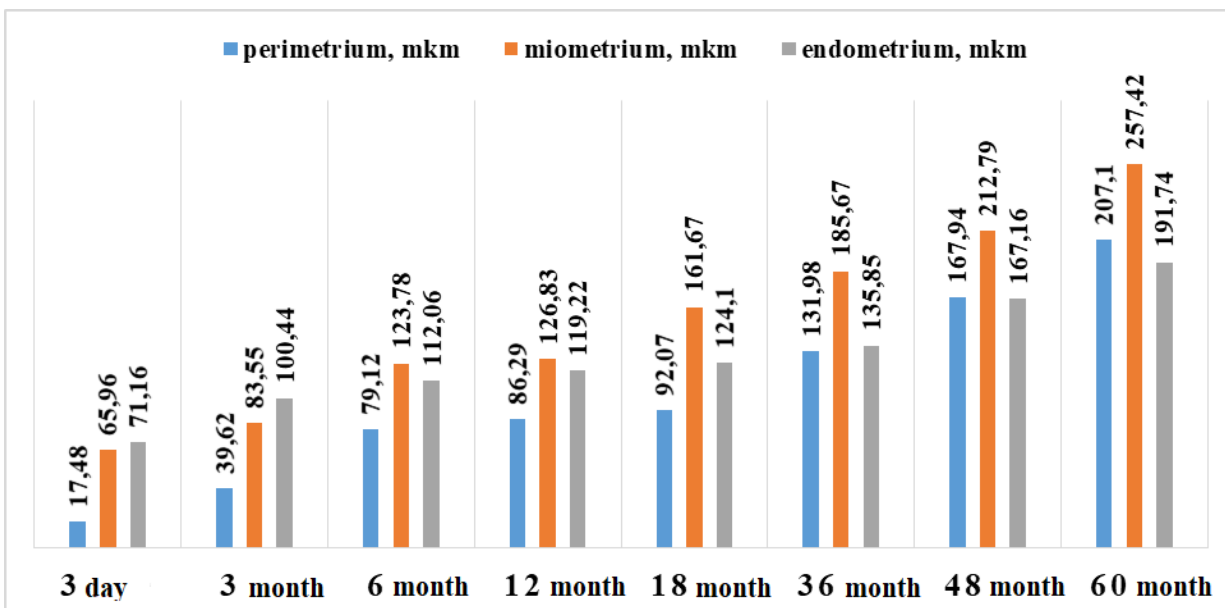


Figure 2. Histological parameters of the uterine body in local-breed goats (M).

Conclusion.

1. In local-breed goats, a regular age-related increase in the absolute thickness of all histological layers of the uterine body wall-perimetrium, myometrium, and endometrium-was established during postnatal ontogenesis.

2. The thickness of the perimetrium of the uterine body was $17.48 \pm 0.678 \mu\text{m}$ in 3-day-old goats and reached $207.10 \pm 6.72 \mu\text{m}$ at 60 months of age. During this period, the overall growth coefficient of perimetrium thickness was 11.85-fold, with the most intensive growth observed during the early stages of postnatal development.

3. The thickness of the myometrium of the uterine body increased from $65.96 \pm 2.598 \mu\text{m}$ in 3-day-old goats to $257.42 \pm 8.01 \mu\text{m}$ at 60 months of age. It was established that the absolute thickness of the myometrium increased 3.90-fold from 3 days to 60 months of postnatal ontogenesis.

4. The thickness of the endometrium of the uterine body was $71.16 \pm 2.925 \mu\text{m}$ during the first 3 days of postnatal development and reached $191.74 \pm 5.48 \mu\text{m}$ at 60 months of age. The overall growth coefficient of this layer during postnatal ontogenesis was 2.69-fold.



5. The dynamics of development of the histological layers of the uterine body wall in goats differed among the individual layers. Specifically, the perimetrium demonstrated the highest growth coefficient (11.85-fold), followed by the myometrium (3.90-fold) and endometrium (2.69-fold). These findings indicate the uneven and differential development of the structural components of the uterine wall during postnatal ontogenesis.

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