

ANIMAL PATHOLOGY, MORPHOLOGY, PHYSIOLOGY, PHARMACOLOGY AND TOXICOLOGY

ПАТОЛОГИЯ ЖИВОТНЫХ, МОРФОЛОГИЯ, ФИЗИОЛОГИЯ, ФАРМАКОЛОГИЯ И ТОКСИКОЛОГИЯ



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Anatomical and Morphological Characteristics of Burmese Python (*Python Molurus Bivittatus*) Raised in Captivity and Pathological Changes in It



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Abstract

Introduction. The Burmese python (*Python Molurus Bivittatus*) is the third largest snake species in the world. In the wildlife, this snake breed is most often found in the countries of South and Southeast Asia, however, in recent years, these beautiful and docile reptiles have become popular around the world as pets. Burmese pythons are kept and bred by specialists in zoos and at zoo exhibitions as well as by amateurs. For keeping at home, it is recommended to purchase a specimen born and raised in captivity and create for it conditions that imitate its natural habitat. Pythons originate from the tropical and subtropical zones, therefore, when kept at home, high air humidity should be maintained, and a water reservoir should be provided for the semi-aquatic reptiles to bathe, which is especially important for correct snake molting. Unfortunately, more and more often these exotic animals become patients of veterinary clinics or die due to various reasons. The aim of the study is to establish the anatomical and morphological characteristics of Burmese python specimens raised in captivity, as well as pathological changes in them upon death.

Materials and Methods. In 2024–2025, two corpses of Burmese python (male and female) from a private collection were delivered to “Khimera” veterinary clinic (Ussuriysk, Primorsky Territory). Cytological, bacteriological and histological studies were carried out to establish the cause of death. The studies were carried out in an artificially lighted dissection room using the method of complete autopsy during which the metric parameters of organs, as well as pathological changes in them were established.

Results. It was determined that the morphometric parameters of the body and internal organs in male and female Burmese pythons differed in size related to the age, whereas some organs were almost of the same length regardless of sex and age. It was established that death of the male python occurred due to acute pneumonia, which could become a background reason for probable drowning. The female python died from acute pneumonia caused by the bacterium *Ochrobactrum anthropi*.

Discussion and Conclusion. The data obtained during the study of the anatomical and morphological characteristics of the internal organs of male and female specimens of Burmese python, and pathological changes in the organs of reptiles upon death, can be used in the practical work of veterinarians and herpetologists.

Keywords: Burmese python, anatomical and morphological characteristics, pathological changes, pneumonia

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Анатомо-морфологические характеристики и патологические изменения у бирманского питона (*Python molurus bivittatus*), выращенного в условиях неволи

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Аннотация

Введение. Бирманский питон (*Python molurus bivittatus*) является третьим по величине видом змей в мире. В дикой природе данная порода змей чаще всего встречается в странах Южной и Юго-Восточной Азии, но в последние годы эти красивые и покорные рептилии стали популярны во всем мире как домашние животные. Содержанием и разведением бирманских питонов занимаются как специалисты в зоопарках и на зоо выставках, так и непрофессиональные любители. Для содержания питона в домашних условиях рекомендуется приобретать особь, рожденную и выращенную в неволе, и создавать ей условия, имитирующие естественную среду обитания. Питоны — выходцы из тропической и субтропической зоны, поэтому в домашних условиях уровень влажности воздуха нужно поддерживать на высокой отметке, а рептилиям, ведущим полуводный образ жизни, обеспечить емкость с водой, в которой они будут иметь возможность купаться, что особенно важно для правильной линьки змей. К сожалению, все чаще эти экзотические животные становятся пациентами ветеринарных клиник или гибнут по разным причинам. Цель исследования — установить анатомо-морфологические характеристики у особей бирманского питона, выращенных в неволе, а также патологические изменения у них при гибели.

Материалы и методы. В 2024–2025 гг. в ветеринарную клинику «Химера» (г. Уссурийск, Приморский край) поступили два трупа бирманских питонов (самец и самка) из частной коллекции. Для установления причины гибели проводили цитологическое, бактериологическое и гистологическое исследование. Исследование осуществлялось в условиях секционного зала при искусственном освещении по методу полного патологоанатомического вскрытия с установлением метрических характеристик органов, а также патологических изменений в них.

Результаты исследования. Определено, что морфометрические показатели тела и внутренних органов у самца и самки бирманских питонов отличаются по размерам, что связано с возрастом, при этом некоторые органы имеют почти одинаковую длину независимо от пола и возраста. Установлено, что гибель самца произошла по причине острой пневмонии и вероятного утопления на ее фоне. Причиной гибели самки стала острая пневмония, вызванная бактерией *Ochrobactrum anthropi*.

Обсуждение и заключение. Полученные в ходе исследования данные, касающиеся анатомо-морфологических характеристик внутренних органов самца и самки бирманского питона, а также патологических изменений в органах при гибели рептилий, могут быть использованы в работе ветеринарных специалистов и герпетологов.

Ключевые слова: бирманский питон, анатомо-морфологическая характеристика, патологические изменения, пневмония

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Introduction. The Burmese python (*Python Molurus Bivittatus* Kuhl, 1820) is a large and robust snake with dark scales and light brown or yellowish markings along its body. These reptiles were long considered a subspecies of the Indian python *P. molurus*, but in 2009 they were recognised as a full value species due to distinctive morphological features, their co-occurrence within the respective habitats, and apparent lack of natural interbreeding [1]. The debates concerning the Burmese python taxonomy have been going on for 200 years and are still unfinished. According to the current scientific classification, the Burmese python belongs to

the phylum *Chordata*, class *Reptilia*, order *Squamata*, family *Pythonidae*, genus *Python*, and species *P. bivittatus* [2].

In the wildlife, the Burmese python is most commonly found in South and Southeast Asian countries, such as Myanmar (Burma), Thailand, Indonesia, and Vietnam. These snakes were brought to the United States in the frame of the exotic pet trade, however, many of them were subsequently released into the wildlife by owners who found reptiles difficult to care, and turned into the invasive species in the unique ecosystems of South Florida [3, 4]. The python also lives in game reserves of India and Nepal [5].

The Burmese python has been listed as endangered in Appendix II of the Convention on International Trade in Endangered Species (CITES). It has been listed as vulnerable in the IUCN (International Union for Conservation of Nature) Red List since 2012, as the population of Burmese pythons in wildlife has declined by at least 30% in the first decade of the 21st century due to such factors as their skin being hunted for, use in the native medicine and food industry, the pet trade, habitat degradation, and other factors [6].

In the wildlife, pythons prefer damp areas of forests and marsh lands, as they like water and can swim well. Sometimes, due to living near water sources, where they feed on mammals, birds, reptiles, and amphibians, they are claimed to be semi-aquatic [7]. This is one of the largest snake species in the world, reaching lengths of up to 7 m or more, with an average length of about 3.5 m [8]. Burmese pythons are dimorphic, with females typically being longer, larger, and heavier than males. The weights recorded in mature females range from 14 to 75 kg, while in males — from 7 to 15 kg [9].

Burmese pythons are oviparous [10]. Males have larger cloacal appendages (vestigial appendages) than females. These are two projections, one on each side of the anus that are extensions of the hind limbs [11]. Burmese pythons have specialised heat-sensing organs on their heads, located on the upper and lower lips: these pits allow pythons to detect warm-blooded prey, especially in low-light conditions or complete darkness. Burmese pythons are ectothermic, they rely on the external heat sources to regulate their temperature. Like other reptiles, pythons are not particularly active and can remain motionless for several days in succession. They begin to move only when food becomes scarce or in the case of threatening danger [12].

Like other terrestrial snakes, Burmese pythons are carnivorous, feeding primarily on mammals and birds. Prey size depends on the snake's size: young pythons can feed on rodents, while adults can eat livestock, adult deer, and even alligators [13]. These non-venomous snakes have rows of recurved teeth specifically designated for capturing and immobilizing prey, while they are wrapping coils around it, contracting their muscles until the victim suffocates. Pythons are opportunistic carnivores (which means they will eat whenever food is offered), therefore, in captivity, they often suffer from obesity. When fasting, the snake has a normal heart volume, but their stomach volume, acidity level, and mass of intestines are reduced. Once food enters the stomach, the snake's heart ventricle increases in size by 40%, facilitating digestion. Its intestines gain mass, and the abdomen expands to produce more acid [14].

The Burmese python is a pet, which brings almost no troubles to its owners, as it requires little care and feeding and has kind temper. They are widely bred in Russia, both by specialists in zoos and at zoo exhibitions, as well as by amateurs. The population of these exotic animals in the

country is growing, and they are becoming the patients of veterinary clinics more and more often, therefore studying the anatomical and morphological structure and any pathological changes in the organs and systems of these reptiles is a relevant objective. Unfortunately, despite the numerous cases of python deaths due to improper care, feeding and disease, the morphological status and the causes of their deaths are studied extremely rarely, often due to the reluctance of owners to provide the material for analysis. In this context, the aim of this study is to establish the anatomical and morphological characteristics of Burmese python specimens, as well as pathological changes in them upon death.

Materials and Methods. In 2024–2025, two corpses of Burmese python (male and female) from a private collection were delivered to “Khimera” veterinary clinic (Ussuriysk, Primorsky Territory) with the interval of 90 days. The deceased specimens were examined at Primorsky State Agrarian-Technological University (Ussuriysk) under artificial lighting using the autopsy method, during which the metric parameters of organs, as well as pathological changes in them were established.

The Burmese pythons under study were a two-year-old male and a one-year-old female. According to the owner, the reptiles were kept in the same room with a shallow pool, at an optimal temperature, and fed the euthanized rodents. On November 2, 2024, the male was found dead at the bottom of the pool, pressed down by the female. After 90 days, on January 31, 2025, the female was found dead.

Morphometric studies were carried out according to the proprietary methodology developed for describing internal organs (linear and weight parameters) [15]. The study began with an external examination of the pythons and recording main morphometric parameters. The names of body parts were listed, and the structural features were localized. The sex of the specimens was determined using a reptile sexing probe (*Nomoy Pet*, China).

Weight parameters of organs were obtained using a Delta KCE-40-21 electronic scale (*Delta*, China) with up to 0.001 g precision. Linear measurements of organs were performed using a measuring tape (up to 1 mm precision) and a Shock Proof electronic caliper (*Union Source Co*, China) with up to 0.1 mm precision. Internal organs were removed, examined and described according to the technique outlined in [16]. During the autopsy, photographs were taken using a Sony Cyber-shot DSC-W350 camera (*Sony*, Japan) to document certain phenomena and objects under study and obtain visual material. The ratio of internal organ masses to body mass was determined by calculating an average indicator of body mass and organs under study, and relative length was calculated by calculating the organ length to body length in a percentage.

Histological examination of lung lobe biopsy material was performed at CYTOVET Office of Veterinary Morphology (St. Petersburg) in compliance with the standard

techniques, including hematoxylin and eosin staining. Cytological examination was also performed at the same facility, using Pappenheim staining method. Bacteriological examination of respiratory tract contents was conducted in the bacteriology laboratory “TAFI-Diagnostics”, LLC (Ussuriysk).

Due to the lack of scientific data on Burmese pythons, various literature and Internet sources were used to write the present article.

Results. External examination revealed that the skin of both specimens had an identical yellowish-brown mosaic pattern with asymmetrical, large, rectangular, dark brown spots of various shape along entire body length of both pythons. Dark stripes ran from the nostrils through the eye area, merging into spots on the neck (Fig. 1).

The body length of the male python was 215.0 cm with a weight of 19.8 kg; the length of the tail was 105.0 cm; the chest girth was 65.0 cm. The body length of the female was 177.0 cm with a body weight of 2.2 kg; the length of the

tail was 21.0 cm; the chest girth was 14.5 cm. The nutritional status of both specimens was good: both the male and the female had significant fat deposits in the body cavities in the form of a garland of light pink fragments of moderately dense consistency (Fig. 2).

During the study of the internal organs, we have identified several morphometric features. The upper jaw of the male was attached to two bones — the lower and the mandibular bone. The teeth were thin, sharp, grey-pink in colour, curved caudally and directed toward the pharynx (Fig. 3). The length of the male's esophagus was 63.0 cm, the mucous membrane was grey-pink and moist. The stomach was elongated, 19.0 cm long, and the mucous membrane was dark red. The length of the small intestine was 60.0 cm, of the large intestine — 37.3 cm. At the junction of the small intestine and the large intestine, there was a cecum 3.5 cm long.



Fig. 1. Corpse of a male Burmese python



Fig. 2. Internal fat deposits in a male Burmese python



Fig. 3. Teeth of a male Burmese python

The anterior chamber of the male's cloaca (coprodeum) continued into the middle chamber (urodeum), where the ureters opened. The cloaca was 8.3 cm long. The size of pancreatic gland was measured 5.5 x 3.0 cm, was grey-pink, and connected by dense ligaments to the spleen capsule. The size of liver was measured 39.0 x 4.0 cm, it weighed 0.15 kg and was located along the lung. The ventral part of the liver contained the choledoch with the strongly-pronounced bile ducts. The gallbladder was 41.1 cm long and 25.7 cm wide. The kidneys were in the form of compact bodies, were located in the pelvic cavity and were dark brown in colour: the left kidney was 15.5 cm long and weighed 0.015 kg; the right kidney was 18.5 cm long and weighed 0.016 kg (Fig. 4).

The heart consisted of a ventricle and two atria separated by a septum. Both atria opened into the ventricle through separate openings. The ventricle was divided into two halves by an incomplete septum to prevent mixing of arterial and venous blood. The atria were 3.1 cm long, and the ventricle was 3.5 cm long. The heart's width at the base was 3.4 cm, and its mass was 10.0 g; the atria were filled with blood (Fig. 5).

The trachea was 48.0 cm long and divided into two bronchi at the entrance to the lungs. The right lung, 60.4 cm long, was delimited by the transition to the air sac, which was clearly visible. The left lung was shorter than the right (5.0 cm), was attached to the liver capsule by ligaments; the air sac was less visible. The lungs had a cellular structure and the shape of an elongated sac; the inner surface of the lungs had a folded, cellular structure (Fig. 6).



Fig. 4. Kidneys of a male Burmese python



Fig. 5. Heart of a male Burmese python, sectioned through the ventricles



Fig. 6. Trachea bifurcation and lung of a male Burmese python after removal of fluid

The male's hemipenes were located in pockets on the ventral side of the tail near the cloaca. Along the edges of these pockets there were anal spurs — bony structures (pseudopods) in the form of small light-yellow claws that were not attached to the spine. The length of the left testicle was 15.5 cm, and of the right — 16.0 cm. In female the paired hemiclitores were found on the ventral side of the tail near the cloaca and anal spurs in the form of small light-yellow claws, half the length of those in the male. The

depth of sexing probe penetration, inserted into one of the female's paired hemiclitores, was 6.0 cm (Fig. 7).

Absolute and relative morphological parameters of the body and internal organs of the male and female Burmese python are presented in Table 1. The ratio of the mass of the internal organs to the body mass was determined, and the length of the organs to the body length, excluding the length of the tail.



a)



b)

Fig. 7. a — female hemiclitores; b — male hemipenes in Burmese python

Table 1

Absolute and relative anatomical and morphological parameters of Burmese pythons

No	Parameters	Unit of measurement	Male	Relative value, %	Female	Relative value, %
1	Body length	cm	215		177	
2	Tail length	cm	105	48.8	21	11.8
3	Chest girth	cm	65	—	14.5	—
4	Body weight	kg	19.8	—	2.2	—
5	Length of the stomach	cm	19	8.83	16	9.32
6	Length of the small intestine	cm	60	27.9	62	35
7	Length of the large intestine	cm	37.3	17.3	41	23.2
8	Length of the cecum	cm	3.5	1.6	3.2	1.8
9	Length of the cloaca	cm	8.3	3.8	6.1	2.8
10	Length of the liver	cm	39	18.3	27	15.2
11	Liver mass	kg	0.15	0.75	0.05	2.36
12	Length of the pancreas	cm	8	2.5	5.5	4.51
13	Length of the left kidney	cm	15.5	7.2	10	5.6
14	Length of the right kidney	cm	18.5	8.6	12.2	6.9
15	Left kidney mass	kg	0.015	0.07	0.006	0.27
16	Right kidney mass	kg	0.016	0.08	0.007	0.31
17	Length of the atria	cm	3.1	1.4	2.2	1.2
18	Length of the heart ventricle	cm	3.5	1.6	2.7	1.5
19	Heart mass	kg	0.01	0.05	0.004	0.18
20	Length of the left lung	cm	5.0	2.3	3.0	1.7
21	Length of the right lung	cm	60.4	28	19	10.7
22	Length of the left testicle	cm	15.5	7.2	—	—
23	Length of the right testicle	cm	16	7.4	—	—

The analysis of absolute and relative morphological parameters in Burmese pythons revealed that the male's body size significantly exceeded that of the female's, despite the age difference between them was only one year. At the same time, the length of the intestine, stomach, cecum, and cloaca was nearly identical in both specimens, despite the difference in body length. At the same time, the length of the liver, pancreas, right and left lungs, and the weight and length of the liver was significantly greater in the male than in the female.

The autopsy revealed that the female had a significant amount of viscous, turbid mucus mixed with blood in its

respiratory tract, and similar mucus was found in the lumen of its trachea (Fig. 8). The anterior segment of the right lung was filled with the grey-yellow catarrhal-purulent contents. The lung tissue was dark red. Four limited areas filled with the catarrhal-purulent contents were found in the left lung (Fig. 9).

The male's trachea contained foamy fluid with yellow flocculent inclusions. The lung sac contained a large amount of thick, turbid foamy fluid containing yellow flocculent inclusions. The lung parenchyma was thickened and red in colour (Fig. 10).



Fig. 8. Viscous mucus in the respiratory tract of a female Burmese python (photo by the authors)

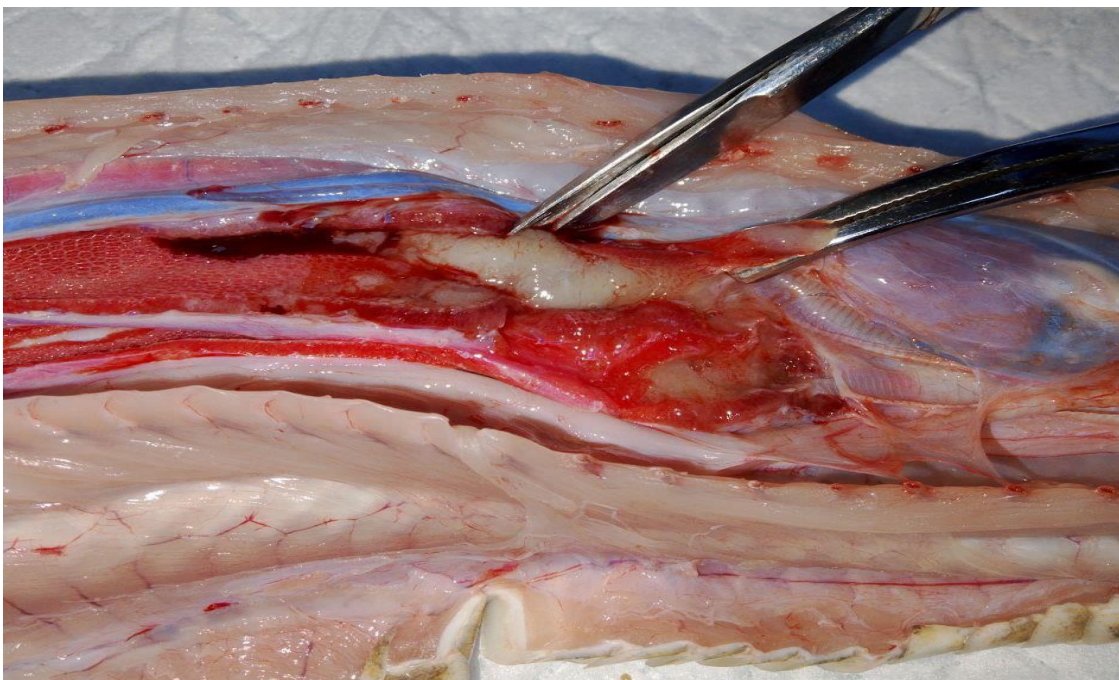


Fig. 9. Catarrhal-purulent contents of the right lung of a female Burmese python

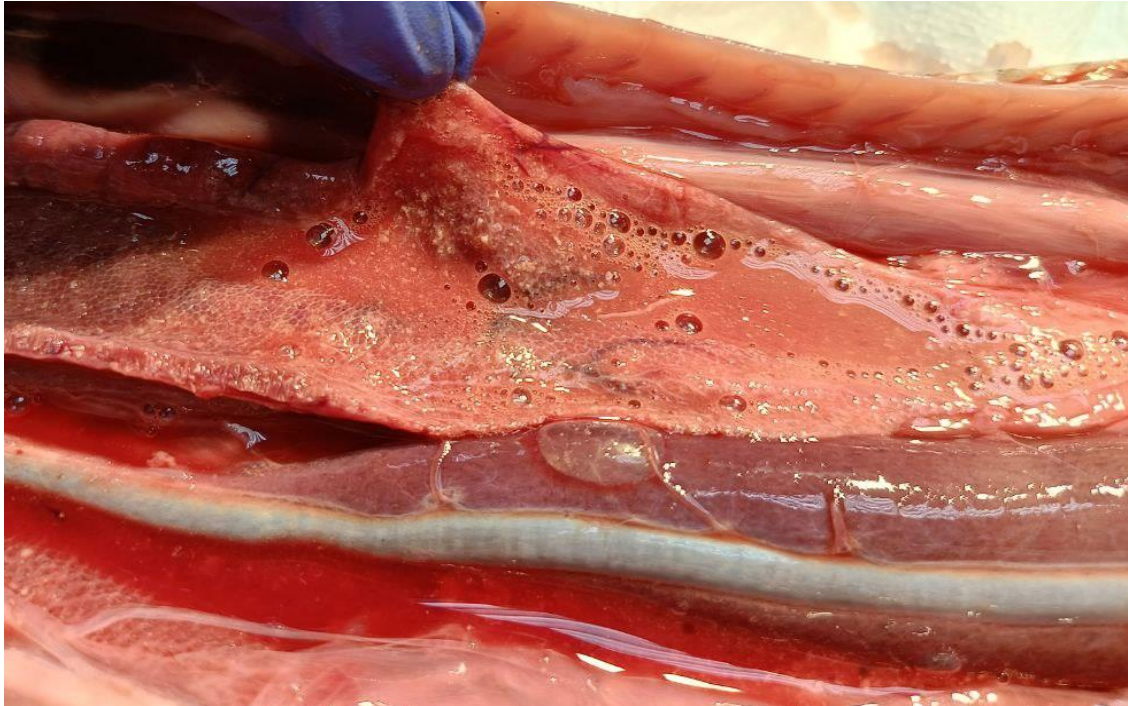


Fig. 10. Fluid in the lung sac of the male Burmese python

Bacteriological examination of sputum from the female's respiratory tract revealed the gram-negative bacterium *Ochrobactrum anthropicus*. Histological examination of the female's lung biopsy material revealed a severe focal inflammatory process in the fa-

veoli, manifested as a moderate heterophilic inflammatory infiltrate associated with accumulation of interstitial fluid in the air spaces (Fig. 11). Bacteriological culture sampling in the male was not performed due to contamination of water in the pool.

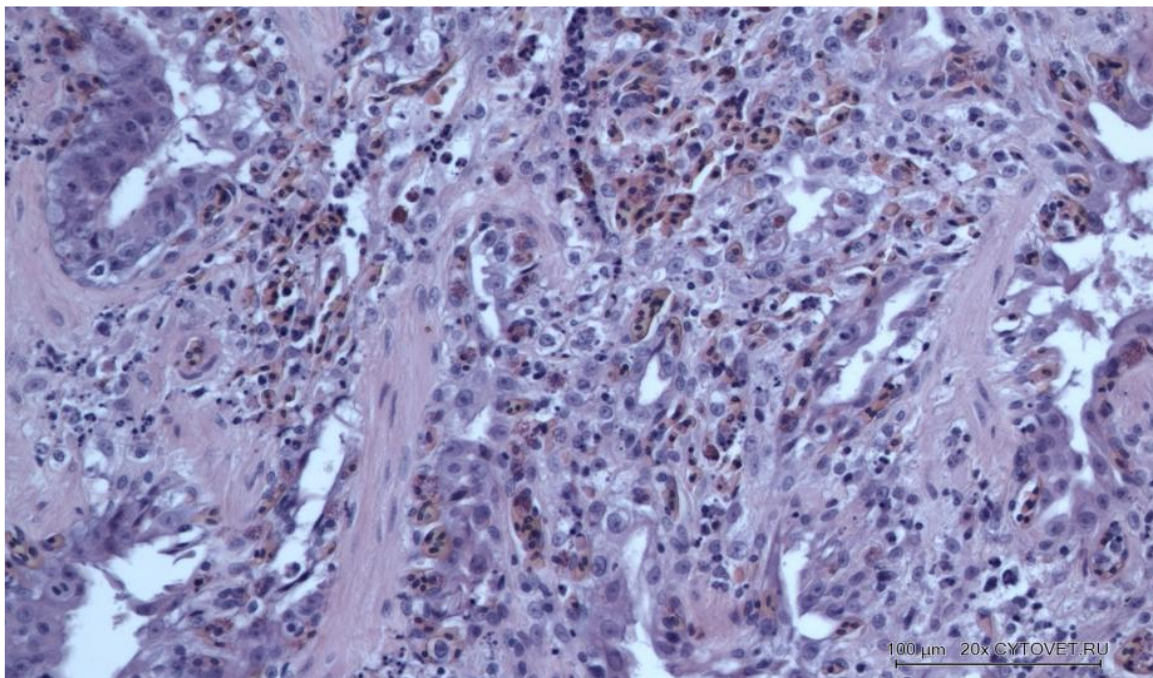


Fig. 11. Focal inflammatory process in the faveoli of the lungs of the female python (hematoxylin and eosin, $\times 200$)

Analysis of the data obtained, brought us to the conclusion that death of the male python was caused by asphyxia due to drowning, pneumonia being a background reason. The female died from asphyxia due to bacterial pneumonia caused by *Ochrobactrum anthropi*.

Discussion and Conclusion. An anatomical and morphological study of the internal organs of two Burmese pythons revealed that the relative mass (index) of the liver in the male was 0.75%, the heart 0.05%, the left kidney 0.07%, and the right kidney 0.08%. With a body length

of 215.0 cm, the relative length of the left lung was 20.9%, and that of the right lung was 28.09%. The metric parameters of the female's internal organs were smaller than those of the male, which was due to its smaller body mass and size. This is clearly evident with the length of the liver, pancreas, right and left lungs, and the weight and length of the liver—these parameters were smaller in the female than in the male. The length of the intestines, stomach, cecum, and cloaca were nearly identical in both pythons.

Although the male was found in a pool, pressed by a female, drowning was not the only cause of the snake's death. According to various sources, the Burmese python is capable of holding its breath for 30 to 90 minutes, reducing its metabolism to 80% in underwater conditions, which allows oxygen reserves to be preserved for a much longer period. Furthermore, pythons have specialised valves that seal their trachea when submerged, larger air capillaries compared to mammals, which allows them to survive long periods of time without breathing, and a high concentration of myoglobin, which binds and stores oxygen, providing an internal reserve [17–19]. Taking into account this resistance to drowning, the male's death could only have occurred if it had been underwater for too long for its aerobic capacity limited by pneumonia, and was unable to get out of the pool in time due to general muscle weakness caused by the disease. Therefore, the presumed cause of death was drowning due to background pneumonia.

According to D.B. Vasiliev, pneumonia is common among reptiles because, due to the absence of a diaphragm, they lack a cough reflex. Evacuation in the trachea and bronchi in both directions is accomplished solely by the ciliated epithelium. During infections of any etiology, the cilia shorten and stick together losing their function almost completely. Therefore, the infectious agents tend to merge and adhere, which leads to the development of focal bronchopneumonia. The disease may progress without specific

symptoms, limited to general depression [20]. According to A.M. Timmerman, the incidence of pneumonia increases when snakes are exposed to stress factors such as overcrowding, unsuitable temperature and humidity, transportation, parasites, etc. [21].

The study allowed us to establish that both Burmese pythons died from asphyxia: the male from drowning due to pneumonia, and the female from acute pneumonia, which may have developed due to a weakened immune system. Due to the saccular, elongated structure of the lungs, the presence of viscous fluid in the female's trachea led to the obstructive reduction of lung respiratory capacity and to limitation of aerobic metabolism.

Pathological changes in the lungs of the pythons studied were consistent with pneumonia, as confirmed by the bacteriological examination of sputum from the respiratory system of the female python. The probable cause of pneumonia was microbial colonization of the oropharynx and respiratory tract by the pathogen, the bacterium *Ochrobactrum anthropi*, and keeping in the confined space might have facilitated transmission of infection.

Ochrobactrum anthropi is a non-fermenting, gram-negative bacterium commonly found in the environment. According to published scientific data, it is a wide-spread soil-dwelling alphaproteobacterium that colonizes a wide range of organisms and is now often recognized as a potentially dangerous opportunistic and nosocomial pathogen that develops in patients with various types of immunodeficiency [22]. According to M.S. Mahmood, the consequences of *O. anthropi* pathogenicity appear to vary greatly in severity depending on the host. It causes bacteremia, which can lead to sepsis and septic shock [23].

We believe that the results we have presented will be useful for identifying the areas of further research in this field, which will undoubtedly be useful to both herpetologists and veterinary specialists.

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