

KEY POINTS OF REPTILE HEMATOLOGY: FEATURES OF ASSESSMENT OF  
THE LEUKOCYTE PART OF BLOOD

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**Abstract.** In herpetology, hematological parameters are widely used in veterinary practice, in environmental and biological studies and as a complex bioindicator. Discrepancies in the interpretation of the results of different studies are due to the characteristics of reptile hematopoiesis and variability in the morphology of leukocytes, which leads to distortions of the real picture. The purpose of the work is to summarize the critically significant multivariate aspects in reptile hematology that are of significant importance for theory and practice.

**Keywords:** hematology of reptiles, research methods, platelets, lymphocytes, neutrophils, heterophils.

## INTRODUCTION

Hematological research as an independent scientific direction, as well as a methodological technique for assessing the condition of animals, has a certain value and is often irreplaceable. For reptiles, hematological parameters are relatively widely used in veterinary practice [1] and, to a lesser extent, in environmental and biological research [2]. In the group under consideration, a complex of hematological parameters serves as a kind of vector and often the only opportunity for assessing the physiological state, health status and an indicator of environmental determinants. The most operational and indicative are the composition and indicators of the leukocyte part of the blood. It is this group of immunocompetent cells among the studied reptile species that is the most variable and does not have a final interpretation. Obviously, this imposes restrictions, the violation of which leads to errors that distort the real picture.

## MATERIALS AND METHODS

The work used our own data (based on the material collected by the author and provided by colleagues) on the morphology of blood cells of nine species of reptiles: *Anguis fragilis*, *Zootoca vivipara*, *Lacerta agilis*; *Eremias arguta*, *Phrynocephalus guttatus*, *Natrix natrix*, *Coronella austriaca*, *Vipera berus*, *V. renardi*. The analysis included literary sources related to the topic of the study and describing the characteristics of the blood of representatives of the class belonging to five taxonomic groups: beaked heads, turtles, crocodiles, lizards and snakes. The results of the work are summarized with a description of the methods and results of studies on the leukocyte part of the blood with the determination of the quantitative and qualitative composition of blood smears. In a number of points, information on the hematology of higher animals and humans was used for comparison. The review touches only on the most controversial features of the blood picture and its interpretation.

**RESULTS AND DISCUSSION**

Unlike higher animals and humans, all reptile cells have nuclei. Thus, platelets at different stages of development or under unsatisfactory conditions of fixation and staining can be mistaken for small or honuclear lymphocytes, which leads to underestimation or overestimation of the proportion of lymphocytes [3]. The likelihood of error increases when mixed cell aggregations form. Differences in elements are associated with a complex of characteristics (Table 1). The most reliable core characteristics.

**Table 1** Comparative characteristics of platelets and lymphocytes in reptiles

Indicators	Platelets	Lymphocytes
Magnitude	Approximately homogeneous	Varies
Cytoplasm	Weakly colored (light gray, light blue), often colorless	Basophilic, occasionally contains granules of various types From round to irregular and angular
Core	Always round-oval in shape	Lymphocytes
Nuclear chromatin	Dense, thickly oriented in the longitudinal direction, deeply basophilic in color, contrasts with the chromatin-free space	Completely fills the space of the core, dense, rough, uniformly colored without sharp transitions with chaotic placement of lumps

One of the controversial issues is the division and nomenclature of leukocytes, especially granulocytes. To a large extent, the classification of mature cells is complicated by the absence of bone marrow barriers in reptiles, which results in the presence of many immature forms in the bloodstream, which are often difficult to identify [4].

The source of errors can be toxicly altered heterophils/neutrophils in animals with infectious or inflammatory processes, which manifests itself in intense basophilia of the cytoplasm and its vacuolization, abnormal granulation (disappearance, increased changes in the color and shape of granules) and segmentation of the nucleus [4].

Monocytes in reptiles are varied in size (8–25 µm) with a varying nuclear shape (round, oval or bean-shaped), the cytoplasm is distinguished by a delicate lumpy structure, often with azurophilic granules, color from gray-blue to blue.

Azurophiles are unique cells for reptiles that exhibit the joint manifestation of characteristics of granulocytes and monocytes [3]. Their nature remains debatable. Different researchers classify them as monocyte or granulocytic lineages, defining them as different stages of these lines, or classify them as independent [4]. Azurophiles are usually observed in squamates and crocodiles and less commonly in turtles. They are round cells with blue-gray cytoplasm containing azurophilic to purple granules; the nucleus is round or oval with a chromatin structure similar to that of monocytes. Cytochemically, snake azurophils are similar to mammalian neutrophils (positive reaction to benzidine peroxidase, black Sudan B and PAS test) [18, 32], while lizard azurophils give a positive reaction to acid phosphatase, negative to benzidine peroxidase and black sudan B, showing similarities to mammalian monocytes, i.e. Despite their morphological similarity in different species, they probably

have different origins. This explanation most fully corresponds to the picture available in various publications and is consistent with quantitative data in animals of different statuses.

## CONCLUSION

The study of the qualitative and quantitative composition of reptile blood leukocytes is associated with a number of difficulties due to both the characteristics of cell morphology, the diffuseness of hematopoiesis, and external factors. Improving the quality of primary material is associated with research methodology and techniques. Today, all difficulties cannot be completely overcome. To assess the quality of the studies conducted and the prospects for their interpretation, a methodological list of signs is proposed, which allows us to further determine the acceptable range of tasks to be solved: 1) time and place of obtaining hematological material; 2) sex, age of animals, sample size of each group; 3) clinical status of individuals (at least size and weight indicators); 4) the number of smears from each individual; 5) description of the technique for preparing, fixing and staining smears; 6) the number of smears examined and the volume of cell samples; 7) links to the source of description of cell morphology and terminology used; 8) during the initial study of the species - providing an image and description of the cells; 9) numerical indicators are given in absolute ( $\mu\text{l}$ ) and specific (%) values.

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