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Blood cell morphology of Djungarian hamster (*Phodopus sungorus*)

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Summary

Djungarian hamsters (*Phodopus sungorus)* are increasingly used as a laboratory model, but published information on their blood cell morphology has not been available. The aim of this study was to describe the morphologic characteristics of peripheral blood cells of *P. sungorus*. Erythrocytes had an average diameter of 6.02 µm, ranging between 4 and 7.5 µm; thus they were smaller than those of other Cricetine (hamster) species. Polychromatic (immature) erythrocytes were relatively abundant, as is common in rodent species. The differential count of leukocytes was similar to that of the golden hamster. The percentage of neutrophils and monocytes was slightly higher than in the golden hamster, while that of lymphocytes was somewhat lower. Neutrophils ranged in size from10-12 µm, containing neutrophilic granules and well-defined nuclear lobes. Lymphocytes diameters were 9-12 µm. Small lymphocytes were the most abundant. Monocytes ranged in size from 10-16 µm, being the largest cells. Eosinophils varied in size from 10-14 µm, and displayed a ringed nucleus.

Keywords: Blood cell morphology; Djungarian hamster

Introduction

The Djungarian hamster (*Phodopus sungorus*) is a small rodent native to the steppes of East Kazakhstan and South-West Siberia. It is noted for having fur along the surface of their feet and a modest, attenuated tail. During summer, the pelage of *P. sungorus* is dark greyish brown on the back and head with a black mid-dorsal stripe. The fur on the underside is whitish to light grey. In winter, *P. sungorus* turns more or less completely white, except for the mid-dorsal stripe. This color change is by far the best diagnostic feature of *P. sungorus* (Hoffmann, 1978).

As well as being a popular pocket pet, Djungarian hamsters are increasingly used as a laboratory model due to unique physiologic properties that facilitate specific studies of disease and behaviour. *P. sungorus* has been studied with regard to circadian rhythm (Ruby *et al*., 1997), photoperiod and its effect on reproduction (Ebling, 1994), torpor (Ruby, 1995), sleep (Larkin *et al*., 2004), hair-coat growth (Paul *et al*., 2007), thermogenesis and fat metabolism (Ebling & Barrett, 2008). The general advantages of Djungarian hamsters as a laboratory animal include their ease of handling, small size and small housing space and a short reproductive cycle.

Information about the blood cell morphology of different species can clarify functional and pathological mechanisms still not well elucidated. The morphological and morphometric description of the types of peripheral blood cells is essential to support the differential diagnosis of disease and allows identification of normal circulating adult cells, as well as aiding the theoretical knowledge about their ontoge-

ny and the functional viability of the haematopoietic organs.

Although many studies have been conducted on the haematology of rodents, published information on blood cell morphology for the Djungarian hamster is not available. The purpose of this study was to describe the morphologic characteristics of peripheral blood cells of *P. sungorus* kept in captivity.

Materials and methods

Twelve Djungarian hamsters from commercial stocks were examined in this experiment. Animals were cared and housed according to the Italian legislation (decree n. 116/1992). Blood was taken by puncturing the tail vein with heparinised syringes, inducing minimal stress in the animals and according to the animal welfare regulations. Four smears per individual were immediately prepared, then they were coded, air-dried and fixed in methanol for 5 minutes. Blood smears were stained following the Pappenheim method with May-Grünwald and Giemsa.

The blood cells were examined with a light microscope (Zeiss Axiophot) at ×1000 magnification. Photomicrographs were captured with the help of Leica Application Suite software (Leica Microsystems), where blood cell morphology was examined. Cell diameters were measured using the open source software ImageJ (developed by the National Institutes of Health). A minimum of 100 leukocytes and 25 erythrocytes per animal were examined. The percentage of polychromatic erythrocytes was determined in 1,000 erythrocytes.

Results and Discussion

The following cells were identified: mature erythrocytes, polychromatic erythrocytes, lymphocytes, eosinophils, neutrophils, monocytes and platelets.

Erythrocytes of *P. sungorus* were acidophilic, anucleated biconcave discs, 4-7.5 μm (mean 6.02±0.24 μm) in diameter, with a distinct central pallor. No Howell-Jolly bodies were observed. Polychromatic erythrocyte percentages varied from 2 to 8%.

Most of the white cells were either neutrophils or lymphocytes, the latter being the most abundant. Neutrophils (Figure 1a) were 30±4.5% of total leukocytes, showed lobulated nuclei (either segmented or unsegmented) and neutrophilic cytoplasmic gran-

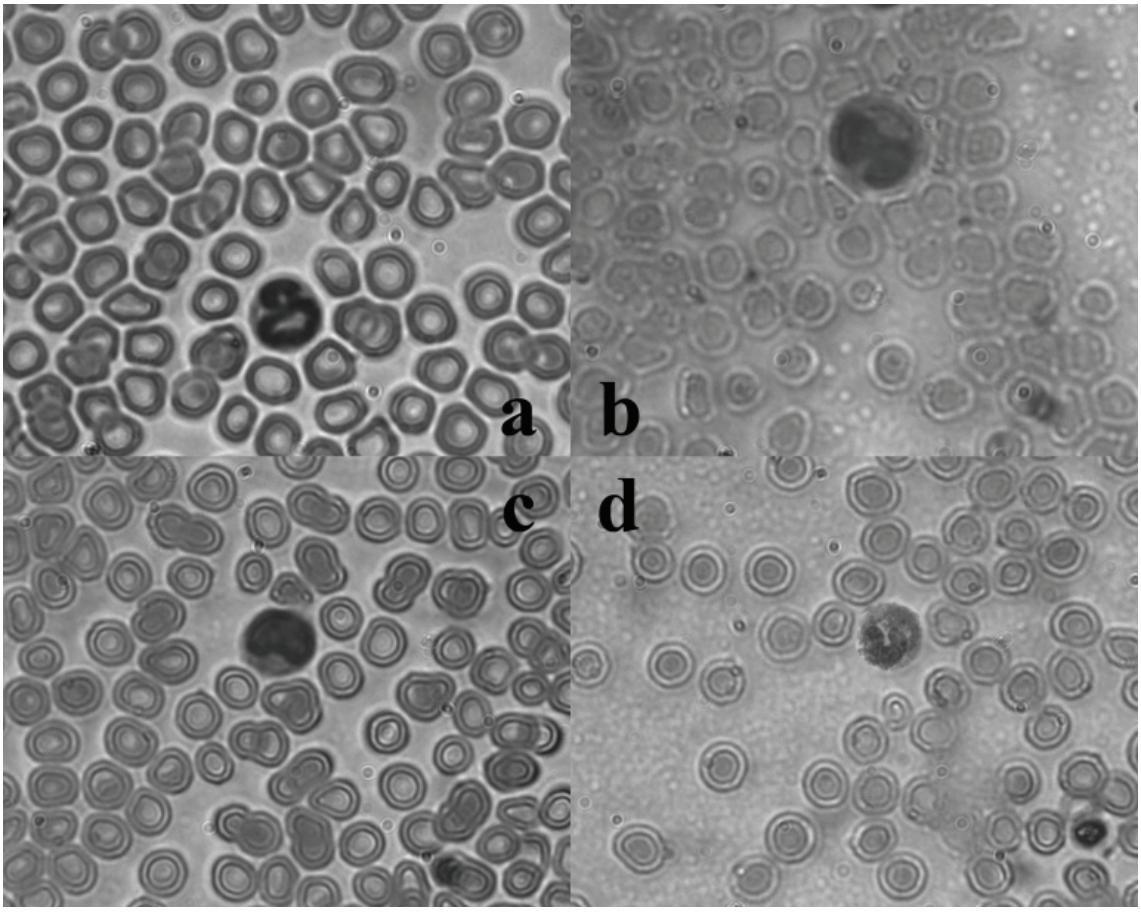

Figure 1. Blood smears of Djungarian hamster: a) neutrophil b) monocyte c) lymphocyte d) eosinophil (May-Grünwald and Giemsa stain), ×1000 magnification

ules. The diameter varied between 10 and 12 µm. Lymphocytes (Figure 1c) were 66±10% and varied in diameter between 9 and 12 µm, being mostly below 10 µm. The dense, dark nucleus occupied most of the cell, while the very narrow band of cytoplasm was light blue. Monocytes (Figure 1b) represented 3±1% and were the largest cells observed with a diameter from 10 to 16 µm. Their distinguishing nucleus was large, indented, resembling a horse-shoe. The cytoplasm was pale-blue stained and vacuolated. Platelets were small with an intensively purple-stained central zone. Eosinophils (Figure 1d) were rare (1%), ranging in diameter from 10 to 14 µm, with a ringed nucleus filling the periphery of the cell. The cytoplasm was filled with bright pink granules. Basophils were not observed in the peripheral blood of *P. sungorus*.

The general features of Djungarian hamster blood cells were not dissimilar from those of the other rodent species. The mean diameter of the erythroctes (6.02 µm) was smaller than that of *Mesocricetus auratus* (6.8 µm) (Chicewicz and Dulemba, 1968) and *Cricetulus griseus* (6.8 µm) (Moore, 1966). This seems to confirm that, among mammals in the same family, smaller species have smaller erythrocytes (Dunaway and Lewis, 1965).

Howell-Jolly bodies were not detected because in this species the spleen selectively removes these erythrocytic inclusions (Udroiu, 2007). The relatively high percentage of polychromatic erythrocytes is similar to that detected in *M. auratus* (Smith *et al.*, 2010): this is a common feature among rodents and is probably due to the relatively short erythrocyte lifespan.

Leukocyte morphology and dimensions were the same as in *M. auratus,* the golden hamster. The percentage of neutrophils and monocytes was slightly higher than in the golden hamster, while that of lymphocytes was somewhat lower.

The results of this study add new information to our knowledge of Djungarian hamster haematology and may provide baseline values useful for veterinarians and biologists dealing with this species both in the laboratory and in the field.

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