HAEMATOLOGIC PARAMETERS ON VARIOUS SPECIES OF STRIGIFORMES AND FALCONIFORMES

ELIZABETH E. SMITH, Office of Pathology, National Zoological Park, Smithsonian Institution, Washington, D.C. 20008, USA.

MITCHELL BUSH, Office of Animal Health, National Zoological Park, Smithsonian Institution.

Abstract: Normal mean values for packed cell volume, total erythrocyte count, total leukocyte count, total protein and mean corpuscular volume were obtained from 37 species of Strigiformes and Falconiformes representing 207 individuals.

INTRODUCTION

Evaluation of medical problems in birds by use of routine hematology has been limited due to the difficulty of performing white blood cell (WBC) counts and the lack of normal values. Standard mammalian WBC counting techniques, based on lysis of the erythrocytes (RBC), cannot be applied to avian blood because lysis of avian RBCs leaves a nucleus similar in size to the WBC.

While selected blood values have been published,[1,2] data are not available for WBC counts. The total WBC count is clinically important for evaluation and monitoring of avian medical problems, as a screening procedure for quarantined birds, and as a method of evaluating the efficacy of various antibiotics used for therapy. In an earlier report[3] we presented preliminary data on 35 birds of prey. This report presents an expanded study of 207 Strigiformes and Falconiformes (Table 1). Samples were obtained from birds exhibited at the National Zoological Park, Baltimore Zoo, and the Wildlife Preserve at Largo, Maryland.

MATERIALS AND METHODS

Birds not considered healthy by physical examination were not included in the baseline data.

To obtain a blood sample, the bird was placed on its back and the feathers removed or separated from the ventral aspect of the elbow to expose the medial (brachial) vein where it passes over the proximal end of the radius and ulna. The area was swabbed with benzalkonium chloride[1] (0.2%), and a 25 or 26 gauge needle on a heparin-rinsed syringe was used to withdraw at least an 0.5 to 1.0 ml sample of blood. When bleeding a small bird, only the needle was inserted into the vein and 2 heparinized capillary tubes (85 microliters each) were filled at the needle hub. The volume of the capillary tubes is sufficient to perform the packed cell volume (PCV), white blood cell count (WBC), red blood cell count (RBC), and total protein (TP).

Blood smears were stained with Wright-Giemsa stain, examined for blood parasites, and then used for a differential count of the white blood cells.

PCV was obtained by the standard micro-hematocrit method. Plasma from the micro-hematocrit tube was placed in a refractometer[2] to obtain TP. Total RBC and WBC counts were obtained by staining the cells with Natt and Herrick's solution.[4] A 20 microliter capillary pipette was filled with heparinized blood and emptied into a reservoir containing 1.98 ml of Natt and

[1] Zephiran chloride, Winthrop Laboratories, New York, New York 10016, USA.

[2] Goldberg, American Optical Co., Instrument Div., Buffalo, New York 14215, USA.

TABLE 1. Hematology values of birds of prey.

	Strigiformes	*Falconiformes*		
	Owls (109)	Eagles (42)	Hawks, Falcons (40)	Vulture, Caracara, Secretary Bird (16)
PCV (%)	41.5 ± 5*	41.5 ± 7	41 ± 5	43 ± 5
RBC ($10^6\mu$l)	2.7 ± .53	2.7 ± .68	3.0 ± 0.6	2.9 ± 0.8
WBC ($10^3\mu$l)	15.6 ± 9.5	19.0 ± 8.3	17.0 ± 9.0	13.8 ± 7.5
TP (gm%)	4.2 ± 0.7	4.3 ± 0.7	4.3 ± 0.7	3.9 ± 0.6
MCV (fl)	154 ± 24	155 ± 25	139 ± 27	154 ± 44

*All values — Mean ± S.D.

Herrick's solution as a diluent, making a dilution of 1:100. The pipette-reservoir assembly[2] was then placed on an aliquot mixer for at least 20 min to ensure adequate staining of the cells. An aliquot of this solution was then delivered to a Neubauer ruled hemocytometer for counting. RBCs were counted in the 4 corner squares and center square of the center 1 mm^2 square and the results multiplied by 5,000. WBCs were counted in all nine 1 mm^3 squares, a factor of 10% added, and this total multiplied by 100 to obtain the total WBCs. Since control systems for counting avian blood cells are not available, it is suggested that a Wright-stained blood smear be examined to approximate the number of WBCs.

RESULTS

The species of Strigiformes examined were Common barn owl *(Tyto alba)* (21); Burrowing owl *(Speotyto cunicularia)* (30); Barred owl *(Strix varia)* (10); Great horned owl *(Bubo virginianus)* (9); Screech owl *(Otus asio)* (18); Scops owl *(Otus s. senegalensis)* (3); Nepal brown wood owl *(Strix leptogrammica)* (3); Snowy owl *(Nyctea scandiaca)* (2); Milky eagle owl *(Bubo lacteus)* (2); Elf owl *(Micrathene whitneyi)* (2); Stripped owl *(Rhinoptynx clamator)* (4); Short-eared owl *(Asio flammeus)* (1); Brown fishing owl *(Ketupa zeylonensis)* (3); Maylayan fishing owl *(Ketupa ketupa)* (1).

The species of Falconiformes studied were White-bellied sea eagle *(Haliacetus leucogaster)* (8); Golden eagle *(Aquila chrysaetos)* (10); Crested serpent eagle *(Spilornis cheela)* (1); Tyrant hawk eagle *(Spizaetus tyrannus)* (1); Tawny eagle *(Aquila rapax)* (1); Bateleur eagle *(Terthopius ecaudatus)* (3); Long-crested eagle *(Lophaetus occipitalis)* (5); Bald eagle *(Haliaeetus leucocephalus)* (10); Imperial eagle *(Aquila heliaca)* (3); Red-

[2] Unopette, Becton-Dickinson, Rutherford, New Jersey 07070, USA.

tailed hawk *(Buteo jamaicensis)* (21); Cooper's hawk *(Accipiter cooperii)* (1); Harris hawk *(Parabuteo unicinctus)* (4); Roadside hawk *(Buteo magnirostris)* (1); Savanna hawk *(Heterospizias meridionalis)* (3); Forest falcon *(Micrastur semitorquatus)* (1); Prairie falcon *(Falco mexicanus)* (1); Osprey falcon *(Pandion haliaetus)* (1); American kestrel *(Falco sparverius)* (7); Black vulture *(Coragyps atratus)* (3); King vulture *(Sarcorhamphus papa)* (1); Hooded vulture *(Necrosyrtes monachus)* (1); Crested caracara *(Polyborus plancus)* (6); Secretary bird *(Sagittarius serpentarius)* (5).

Nucleated RBCs of birds prevent use of the standard mammalian technique for counting WBC and RBC. Shaw's[5] solution was evaluated as a diluent and found unstable. Quality was not maintained, even when frozen until used. In contrast, the Natt and Herrick's solution could be prepared in advance, remained stable at room temperature, and could be stored 6 months or more with minimal staining distortion. Dispensing the diluent into disposable reservoirs and sealing with paraffin prevented evaporation, facilitating use in field work. The methyl violet in Natt and Herrick's solution differentially stains the cellular components and facilitates differential counting of the RBC and WBC. The nucleus of the RBC stain violet with slightly lighter cytoplasm. The more rounded WBC stains a uniformly dark violet. The nucleus of the smaller elliptical thrombocyte stains a light violet with a very faint violet cytoplasm.

DISCUSSION

The PCV values of all raptors are very consistent. A PCV 10-15% below normal suggests anemia, possibly due to intestinal parasites, blood loss, or inadequate nutrition. An elevated PCV indicates probable dehydration and supportive fluids should be considered if other clinical signs confirm dehydration. The RBC count of hawks and falcons differ slightly from the others in that they are smaller and more numerous. The WBC values are relatively close, with eagles having the highest normal values. The WBC count is of particular significance, as an elevated WBC count usually indicates infection, upon which the bird is started on antibiotic therapy. This therapy is monitored by subsequent white blood counts, and if the WBC count does not return to normal levels in 3-5 days, or continues to increase, a different antibiotic is selected. If the WBC count continues to remain elevated, a fungal infection is suspected and laparoscopy and/or tracheal washings are performed in an attempt to obtain a specific diagnosis.

The TP is a valuable test for evaluating the general nutritional state of a bird and can be a useful aid in determining some infectious processes. We have seen this in chronic diseases such as tuberculosis, where the TP is markedly elevated. In addition, a low TP is indicative of malnutrition. These birds should be force fed, tube fed, and/or supportive fluids administered. In our experience, it is very difficult to save a bird presented with less than 2.0 gram percent TP in spite of extensive supportive treatment.

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