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Case Report—

Avian Simuliotoxosis: Outbreak in Louisiana

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SUMMARY. From April 20 to May 10, 2010, multiple species of birds were seen at the Louisiana State University (LSU) Zoological Medicine Department for a disease syndrome characterized by acute lethargy, generalized subcutaneous petechiae, vasculitis, and death caused by a black fly identified as Simulium meridionale. Twenty psittacine birds presented with severe depression and multifocal subcutaneous hemorrhages over the body and especially noted in the featherless areas of the head and neck. Ten out of 20 clinical cases seen survived on a treatment regimen consisting of intravenous fluid therapy, anti-inflammatories, antihistaminic medications, and supportive care. The 10 other birds likely died of cardiopulmonary collapse and anaphylactoid reactions. In all post mortem examinations multifocal to coalescing dermal hemorrhage, eosinophilic dermatitis, severe edema, and vasculitis were observed. The LSU School of Animal Science conducted a brief survey that included 34 of the 64 Louisiana parishes and showed that 17 parishes, at least, were affected by this outbreak. A total of at least 225 poultry bird deaths could be attributed to black fly strikes. Simuliotoxosis outbreaks have previously been reported in North America, and this report documents the clinical and post mortem findings, treatment response, and extent of such an outbreak in pet and farm birds in Louisiana.

RESUMEN. Reporte de Caso—Simuliotoxosis aviar: Brote en Louisiana.

Del 20 de abril al 10 de mayo del año 2010, se observaron múltiples especies avíneas en la Universidad Estatal de Louisiana (LSU) Departamento de Medicina Zoológica con un síndrome de enfermedad que se caracterizaba por letargo agudo, petaquias subcutáneas generalizadas, vasculitis y muerte que fue causado por la mosca negra identificada como Simulium meridionale. Veinte aves psitácidas presentaron depresión severa y hemorragias subcutáneas multifocales sobre el cuerpo y que eran aparentes especialmente en las áreas sin plumas de la cabeza y del cuello. En diez de los 20 casos clínicos recibidos, las aves sobrevivieron con un régimen de tratamiento que consistía en terapia de fluidos por vía intravenosa, antiinflamatorios, medicamentos antihistamínicos y otros procedimientos de apoyo. Las otras diez aves probablemente murieron por un colapso cardiopulmonar y reacciones anafilácticas. En todos los exámenes post mortem se observaron hemorragias cutáneas multifocales que se fusionaban, dermatitis eosinofílica, edema severo, y vasculitis. La Escuela de Ciencia Animal de la Universidad Estatal de Louisiana llevó a cabo un breve muestreo que incluyó a 34 de las 64 parroquias de Louisiana y mostró que al menos 17 parroquias se vieron afectadas por este brote. Un total de al menos 225 aves de corral murieron podrían atribuirse a los ataques por la mosca negra. Se han reportado previamente brotes de simuliotoxosis en América del Norte, y en este informe se documentan los hallazgos clínicos y post mortem, la respuesta al tratamiento, y la extensión del brote en aves de compañía y de granja en Louisiana.

Key words: simuliotoxosis, black flies, vasculitis

Abbreviations: CBC = complete blood count; IV = intravenous; LSU = Louisiana State University; SVM = School of Veterinary Medicine; VTH = Veterinary Teaching Hospital

Members of the family Simuliidae, commonly known as black flies, are of medical and veterinary significance throughout the world (1,2,3). Females of many simulid species are obligate blood feeders. During simuliotoxosis, swarms of black flies feed, resulting in the death of mammalian and avian species from toxemia, shock, or exsanguination.

Ornithophilic species have historically fed on a variety of birds, including galliformes, ratites, passerines, and psittacines (a yellow head amazon, Amazona ochrocephala oratrix; a blue and gold macaw Ara ararauna; and two umbrella cockatoos, Cacatua alba) (14). Black flies are also potential health concern because they may transmit pathogens such as nematodes, viruses, and protozoans such as Leucocytozoon. Historically, in the Mississippi River Valley, simuliotoxosis has been associated with the death of livestock (2) with no ornithophilic outbreak reported in Louisiana.

CASE HISTORY

For a period of about 3 weeks during the spring of 2010, a disease condition characterized by acute lethargy, subcutaneous petechiation, and vasculitis was observed in multiple species of birds presented for treatment to the zoological medicine department of the Louisiana State University (LSU) School of Veterinary Medicine (SVM) and for post mortem examination to the Pathobiology Department of the LSU SVM. The condition was observed by owners and caretakers in relation to the presence of a large number of black flies in the vicinity of the birds or observed biting the birds. In all birds, the clinical course of disease was peracute or acute and occurred within the first 24 hr or less of birds being bitten, when observed. Birds that were presented ante mortem were severely lethargic, fluffed up, and depressed. Multifocal coalescing areas of petechial to ecchymotic hemorrhage were observed over the entire body with more severe and frequent lesions noted over the apertures of the head, neck, and vent regions (Figs. 1 and 2). Some birds presented with signs compatible with cardiopulmonary collapse and anaphylactoid reaction. Numerous simuliidae were observed around
orifices of the head and vent, as well as sparsely scattered throughout the feathers. All birds had similar husbandry conditions and were kept in similar outdoor aviaries that were close to a wooded area or near standing water. The age range of affected birds varied from 2 to 32 years. A total of 20 psittacine birds were presented and included Amazon parrots (Amazona spp.), African gray parrot (Psittacus erithacus), white bellied caique (Pionites leucogaster), galah (Eolophus roseicapilla), and macaws (Ara spp.). Of the macaws, scarlets (Ara macao), green winged (Ara chloroptera), catalinas (Ara ararauna x macao), and blue and gold macaws (Ara ararauna) were represented, with blue and gold macaws comprising 12 of these psittacine birds.

Blood was collected from the right jugular vein for complete blood count (CBC) and biochemistry analysis. Blood smears were performed on all affected animals that presented to the LSU SVM Veterinary Teaching Hospital (VTH), and all were negative for Leucocytozoon spp. The most common abnormal results of the CBC were leukocytosis (43,500–58,900 cells per cubic millimeter of blood), and concurrent heterophilia (43,000–57,000 cells per cubic millimeter of blood). The packed cell volume ranged from normal (40%–50%) to decreased (20%). Plasma biochemistry did not reveal any specific abnormalities apart from mild to moderate elevation in creatine kinase.

**TREATMENT**

For birds that were severely dehydrated or in shock, an intravenous (IV) catheter was placed in the basilic vein, and a shock dose of 80 ml/kg of crystalloid (Lactated Ringers, Hospira Inc., Lake Forest, IL) was administered intravenously as well as subcutaneously. Colloids, such as hetastarch (Hospira), were administered at a volume of 10 ml/kg intravenously over a 15-min interval as needed. Birds were placed on supplemental oxygen via mask followed by oxygen chamber as needed. Animals were administered diphenhydramine (Baxter Healthcare Corp, Deerfield, IL) intramuscularly in the pectoral muscle at 2 mg/kg every 12 hr for a total of 3 dosages and meloxicam (Boehringer Ingelheim, Vetmedica Inc., St. Joseph, MO) at 1 mg/kg orally twice daily. Enrofloxacin (Bayer Healthcare, Animal Health Division, Shawnee Mission, KS) was also administered orally at 15 mg/kg twice daily to prevent secondary bacterial infection. If birds did not respond to initial treatment of fluid therapy, IV dobutamine was administered at 7 mcg/kg/min (Abbott Laboratories, Abbott Park, IL) in constant rate infusion. For a few birds that remained dyspneic despite these efforts, aminophylline (Hospira) was administered at 5 mg/kg orally twice daily. Cutaneous 5 mm biopsies of affected facial areas were collected on three of the birds that presented with simuliotoxicosis to the VTH. Of the 20 birds presented to the VTH, 10 birds died from complications related to multiple fly bites, and their bodies were submitted for necropsy.

**NECROPSY**

Post mortem examination of the 10 birds submitted for necropsy from the VTH all possessed similar lesions consisting of multifocal to coalescing dermal hemorrhage, eosinophilic dermatitis, severe edema, and vasculitis. Lymphoplasmacytic infiltrate was observed adjacent to vessels and feather follicles. Lymphocytes were also noted within vessel walls. Several vessels had degenerated mesangium and occasional fibrinoid necrosis. The superficial dermis contained multifocal areas of necrotic cells near the epidermal-dermal junction (Fig. 3). Toluidine blue staining (Fig. 4) showed an increase in mast cells, which were arranged in rows along dermal capillaries, and the eosinophilic (rather than heterophilic) component of the dermatitis was confirmed with Luna’s eosinophil stain (Fig. 5). The lungs were diffusely congested and frequently contained isolated or aggregated eosinophils. Macrophages were observed surrounding airways that contained black pigment, and numerous airways contained evidence of hemorrhage. The spleen of most birds contained centers of lymphoid nodules that frequently included pyknotic and karyorrhectic debris and large aggregations of eosinophils. Moderate to marked extramedullary hematopoiesis was observed throughout the spleen.

**ADDITIONAL EPIDEMIOLOGICAL INVESTIGATION**

Because of the alarming number of cases seen in a short period of time with identical clinical presentations, the LSU School of Animal Sciences was contacted to gather more information on ongoing epidemiological investigations in the state and on the nature of the flies. A phone and on-site survey from April 24 to May 12 was conducted at poultry farms and included 34 of the 64 Louisiana parishes. Results showed that 17 parishes had evidence for nuisance
caused by increased black fly population that, at least, caused adverse health effects on 63 “backyard” poultry operations (Fig. 6). Of those flocks, more than 225 bird deaths were attributed to fly bites and their consequences. In the affected areas, some birds were observed with hundreds of flies covering their heads. Twelve affected sites were sampled as well as flies collected from psittacines presented to LSU SVM VTH for a total of 314 flies and were submitted to the LSU Entomology Department. All of these flies were identified as Simulium meridionale, commonly known as the “turkey gnat.” Eleven of the 12 collections consisted entirely of females.

DISCUSSION

The range of S. meridionale is widespread, originating from northeastern Canada to Florida, along the U.S. Gulf coast to Texas, and north into Kansas (1). Simulium meridionale are prevalent throughout the Mississippi Valley, where breeding occurs in bayous and flooded areas. The life cycle of S. meridionale is typically multivoltine; however, in the Gulf Coast states a single generation is produced per year. In the southern United States, females deposit their eggs in late winter and early spring, and larvae begin to hatch during the fall (1,2). Adult populations typically emerge in late winter or early spring and are able to live for approximately 3–4 wk at 21–25 C (17). Biting and engorging requires a series of appropriate phagostimulants such as temperature, light intensity, wind speed, humidity, and others factors (2). Black flies are pool feeders that penetrate the skin and produce small craterous lesions using a slashing or biting method with their stylet or labium of the mouthparts (16). The female black flies’ salivary proteins are then injected at the injury site, which allows the blood meal to maintain a fluid state due to the anticoagulatory properties present in the saliva. This complex of proteins includes destabilase and apyrase, modulators of platelet aggregation; proteins that promote local anesthesia; proteins that are antagonists of thrombin, factor V, and factor Xa; serine proteases (13); vasodilators such as histamine (6,7,8); and multiple modulators that cause cellular immune responses (5). Bites cause localized tissue damage and may produce blood loss anemia if they occur in sufficient quantities. The host reaction to fly attacks may include systemic illness, allergic reaction, circulatory shock, or even death (10,15). In 1979 Harwood and James referred to a systemic reaction to black fly bites in humans as “black fly fever” characterized by headaches, fever, nausea, adenitis, generalized dermatitis, and allergic asthma (11). The pathogenicity of black flies for birds has not been well established. However, it is believed that the systemic anaphylaxis was induced from the allergic reaction of the host due to the black fly saliva, resulting in generalized release of mast cell mediators, including histamine (8). These mediators initiate the severe hypotension, vasculitis, pruritus, and edema that was observed clinically and histologically (8,10).

In this case report, the pathology observed at necropsy was consistent with dermal necrosis, eosinophilic dermatitis, and vasculitis, caused by multiple fly strikes of S. meridionale. The time of year and duration of the outbreak were consistent with the life cycle of the black fly (2,17). Before the outbreak, Louisiana had an unusually mild and wet spring. This weather pattern could have contributed to an unusually large population of Simuliidae. Although the extent of mortality has not been studied in depth, more than 235 animal deaths were reported as secondary to multiple black fly bites during the April 20 to May 10, 2010, outbreak in Louisiana. This is the first documented simuliotoxosis outbreak in captive birds in Louisiana. The impact of simuliotoxosis on populations of wild birds is not clear. However, no wild birds that came in to the LSU Wildlife Hospital or Louisiana State Diagnostic Laboratory during the period of the outbreak showed any signs of fly strikes. It is likely that wild birds were not as severely affected...
because these animals were not confined. In contrast to most simuliids, *S. meridionale* females will readily enter outdoor shelters, which could explain the distribution of effective animals. For future outbreaks, indoor daily confinement or a protocol using small mesh netting and multiple fans could lessen losses. Spraying birds with Permethrin-based applications may also be beneficial and decrease mortality. In addition to simuliotoxicosis, black flies have been implicated in carrying and spreading pathogens such as *Leucocytozoon* (9,12,18). Leucocytozoonosis have been reported in chickens (Asia, Africa), turkeys (North America), waterfowl (North America, Europe), and a number of free-living and captive avian species throughout the world (12,18). Many species of *Leucocytozoon* are known, but only a few are known to be pathogenic to their hosts. The pathogenicity varies with host species and age, geographic location, and vector abundance (4). Several species cause significant mortality in domestic waterfowl and poultry resulting from anemia caused by antienzymatic factors produced by the parasite. No blood-borne parasites were seen in any of the birds that presented at LSU SVM. In addition to simuliotoxicosis, cofactors producing stress, such as concurrent disease processes and environmental factors, may potentially have increased the mortality rates during this outbreak.

From April 20 to May 10, 2010, an outbreak of *S. meridionale* caused significant morbidity and mortality in captive outdoor birds in Louisiana. The underlying cause of this outbreak is unknown at this time; however the abundance of adult black flies during 2010 could correlate to the mild winter and spring. The 3-wk time period correlated with the black flies’ life cycle from emergence to mating and engorging to producing offspring. Monitoring bird populations during this period of high risk may prevent deaths if a diagnosis can be made quickly and appropriate therapy instigated promptly in the future.

**REFERENCES**


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