AVIAN POX

Avian pox has long been recognized as a disease of economic importance in commercial poultry operations. It has also plagued pigeon and canary fanciers. Avian pox has a worldwide distribution and has been described in more than 60 species of birds representing some 20 families, but only in recent years have we begun to see its importance in newly imported psittacine birds. Pox is a common finding in psittacine birds imported from South and Central America. Poxvirus infections may also occur in stable, captive avian populations if the disease is brought in by free-ranging birds or insect vectors.

In many cases, pox is a mild and self-limiting cutaneous disease. In more severe forms, the lesions may be generalized and can occur on almost any part of the skin, or the mucous membranes of the mouth, larynx, and trachea. Such lesions cause an extensive fibrinolytic process and high mortality.

ETIOLOGY

Avian pox is a large DNA virus with a viral envelope. Poxviruses are the largest animal viruses. Multiplication occurs in the cytoplasm of infected cells and produces characteristic cytoplasmic inclusions called Bollinger's bodies.[9]

The virus is isolated on the chorioallantoic membrane (CAM) of embryonated chicken eggs or in fibroblast cell cultures of chicken embryos. Subgroups may often be differentiated by their characteristic macroscopic lesions on the CAM and their cytopathological effects in cell culture.[9, 11]

Avian poxviruses have classically been divided into four subgroups: fowl, turkey, canary, and pigeon poxviruses. Parrot poxviruses have some properties, that make them appear to be a distinct group. While many strains exist and are adapted to various avian hosts, all are considered to be variants of the same species, *Poxvirus avium*. Gerlach reported 17 distinct types of avian poxviruses. Other types that have been described include falcon, waterfowl, junco, quail, sparrow, starling, parakeet, lovebird, woodpecker, silvereye, crane, and penguin poxes.[2, 9, 12, 14]

Avian poxviruses do not affect mammals. Most strains, however, do not keep strictly to the avian species for which they are named. They may cause a more severe disease in another host or no disease at all. In any bird that recovers from clinical illness, strong immunity follows. Some strains will also immunize birds against one or more different poxviruses. A true carrier state does not exist in poultry, but latent infection may occur.[9, 11]

EPIZOOTIOLOGY

Poxviruses are shed in the saliva, nasal secretions, and lacrimal fluids; they are also occasionally shed in the feces. The virus is isolated most readily from scabs or diphtheritic lesions.

Transmission may occur by direct contact with infected birds or with contaminated cages, food, or water. Infection in poultry requires a skin wound to allow entrance of the virus. These wounds may be caused by pecking. *Culex* and *Aedes* mosquitos may be mechanical vectors and may remain infective for several weeks. Other suspected means of transmission include ingestion of contaminated food or drinking water, inhalation of dust containing the virus, or by pecking.[9]

After the poxvirus gains entrance through the skin, viremia occurs. Gerlach reports a double viremia in which the virus first localizes in the liver and bone marrow. During the second viremia, the virus returns to the blood, moves to the skin and mucosa, and causes the skin proliferations and diphtheroid deposits.[12]

CLINICAL DISEASE

Parrot Form

Two forms of parrot pox are clinically recognized: dry or cutaneous pox and wet or diphtheritic pox. The cutaneous form is characterized by discrete, nodular, proliferative lesions that form on unfeathered parts of the body such as the cere, facial skin, eyelids, and feet. These lesions begin as vesicles, which form at four to ten days postinoculation (dpi). They progress to papules and then to scabs, which fall off by 23 to 30 dpi; often they leave a small scar. Systemic effects are rarely seen. In this form, the disease is usually self-limiting and is virtually without mortality.[6]

The diphtheritic form is characterized by the extensive fibrinolytic lesions that occur in the mucous membranes of the oropharnyx, eyes, upper respiratory tract, and esophagus. A differential diagnosis of the mouth lesions should include trichomoniasis, candidiasis, and hypovitaminosis A.[5, 6, 15]

In a group of mixed species, the same virus may produce both the wet and dry forms, depending on the resistance of the species infected. For example, blue-fronted Amazons (*Amazona aestiva*) develop severe diphtheritic pox, whereas adult blue-and-gold macaws (*Ara ararauna*) develop dry pox lesions when exposed to the same virus.[6]

Pharyngeal lesions of wet pox in psittacine birds develop at seven to ten dpi. These lesions begin as superficial, raised white plaques in the hard palate and as edema and whitening of papillae on the choanal cleft. The lesions progress to swelling of the choanal and perilingual tissues and the formation of white caseous masses in choanal, pharyngeal, and lingual areas. At 14 to 28 dpi, the masses darken and harden. If the lesions are removed in the caseous or scab stage, the underlying tissues will ulcerate and bleed.[6, 15]

Eye lesions appear at 10 to 14 dpi. The first sign observed is mild blepharitis and a clear, watery ocular

discharge. In most cases, eye lesions are unilateral. The lid swells, followed by excessive tearing and pasting. Caseous white masses and fluids collect under the lid, and the cornea becomes edematous and ulcerated. These ulcers may become chronic or may perforate. At 12 to 18 dpi, dry, crusty scabs begin to form around the margins of the lid and may completely seal it shut. These scabs may become quite extensive and remain attached to the lid for weeks.[5, 6, 15]

Caseous lesions may extend into the esophagus, crop, trachea, and bronchi. Sinusitis, pneumonia, and air sacculitis are commonly associated with pox. Foot lesions are uncommon in most species of psittacine birds but occur commonly in lovebirds (*Agapornis* sp.) and have been observed in Patagonian conures (*Cyanoliseus patagonus*) and blue-and-gold macaws. Crusty papules or scabs often occur on the cere, around the external nares, and at the commissures of the beak.[5, 6]

Morbidity and mortality rates vary greatly among affected flocks. This variation is caused by many factors: species, age, virulence of the virus, stress, concurrent parasitism or disease, housing conditions, nutritional status, and, possibly, environmental temperature. Viruses found in various South American countries vary not only in virulence but also in organ specificity. Strains that cause caseous deposits in the trachea and bronchi are more deadly than viruses predominantly producing eye lesions.[5, 6]

Painful pharyngeal lesions and impaired vision make eating difficult, and wasting is commonly seen. Most deaths are the result of pneumonia, bacterial septicemia, inadequate food intake, or suffocation due to diphtheritic tracheal plugs. Secondary bacterial or fungal infections are common and are responsible for many of the deaths. Bacterial septicemias caused by *Escherichia coli* and *Pseudomonas* are also common. *E. coli, Pseudomonas,* and *Proteus* usually invade the eyes and sinuses. *Candida albicans* is isolated from the mouth, esophagus, crop, and feces. *Aspergillus* is often found in the air sacs and in some birds results in a fulminating mycotic septicemia.[5, 6]

Clinical illness usually lasts two to eight weeks. Most deaths occur during the second week after the appearance of lesions (approximately 20 to 30 dpi). The mortality rate drops dramatically after the third week of illness, except in birds with chronic respiratory disease.[5, 6]

Many birds that recover will suffer residual effects. Subepithelial corneal crystals often occur after ulceration or ketatitis. Distorted lids, loss of pigmentation and filoplume lashes, and chronic corneal ulcers commonly occur. Epiphora may occur because of damage to the lacrimal drainage apparatus. In some cases, the eye may be lost as the result of perforated ulcers or panophthalmitis.[5, 6]

The choanal cleft is commonly scarred with loss of papillae and depigmentation. Pox lesions on the cere may disrupt germinal epithelium of the beak, which results in loss of the horny layer of the beak and replacement with a smooth, skinlike, unpigmented surface. Pitting and secondary fungal infections may occur in the beak. Tissues of the cere and nares may be permanently disfigured and depigmented.[5, 6]

Chronic respiratory disease commonly occurs after pox. Sinusitis and inflammation of the air sacs may exist for months after recovery from an active pox infection. Secondary aspergillosis may occur.[5, 6]

Boosinger and coworkers reported on the development of skin lesions in chickens that were experimentally inoculated with a parrot poxvirus isolate; however, no oral, esophageal, or tracheal lesions were observed. This virus was isolated from parrots showing the severe diphtheritic form of psittacine pox.[2]

Histopathology. Microscopic lesions are characterized by epidermal hyperplasia consisting of ballooning degeneration, intraepithelial vesicles, and eosinophilic cytoplasmic inclusions (Bollinger's bodies). These lesions are seen at the lid margins, in the feather follicles of the filoplume lashes, and on the outer surface of the lids. Oral plaques consist of necrotic central areas filled with cellular debris. Proliferative lesions with inclusion bodies are seen at the periphery of the necrotic lesions. Brickshaped pox virions in inclusion bodies can be found by electron microscopy.[15]

Species Susceptibility to Parrot Pox. Species susceptibility was determined by clinical observation of infected birds and by experimental inoculation with a virulent virus. A great deal of variation in susceptibility has been observed and is dependent on a large number of variables (Table 16–1). All ages are susceptible, but young birds are most severely affected.

Parrot pox is commonly seen in some species of psittacine birds, including blue-fronted Amazons and maximilian (*Pionus maximiliani*), dusky (*Pionus fuscus*), and blue-headed pionus (*Pionus menstruus*). These birds are usually exposed to pox before they enter the United States and develop the disease while in quarantine. The disease can be very serious in these species.[5, 6]

A virulent strain of parrot poxvirus was isolated from blue-fronted Amazons imported from Bolivia and was used extensively in experimental feather follicle inoculations. Although this virus produces a severe diphtheritic systemic disease in the Amazons and in many other species, it produced only dry pox scabs in adult blue-and-gold macaws in both natural and experimental infections. Lists of resistant species were determined by experimental challenge or natural exposure. This is, however, a relative resistance rather than an absolute one. These species may be susceptible when they are young, immunosuppressed, or under adverse conditions. For example, diphtheritic pox lesions will occur in very young blue-and-gold macaws that are imported as hand-fed babies (usually aged two to four months), and these infections may result in high mortality. For another example, African gray parrots (*Psittacus erithacus*) that have aspergillosis are susceptible to pox, but healthy African grays are resistant.[5, 6]

Many other species are not commonly affected but develop serious disease when exposed to poxvirus. These include rosellas, Australian parakeets, many

Table 16–1. SUSCEPTIBILITY OF PSITTACINE BIRDS TO PARROT POXVIRUS

Pox-Resistant (or Rarely Affected) Birds	
Cockatoos	(Family Cacatuidae)
Cockatiels	*Nymphicus hollandicus*
Large macaws	Some *Ara* sp. and *Anodorhynchus hyacinthus*
African parrots	*Psittacus* sp. and *Poicephalus* sp.
Lories and lorikeets	(Family Loriidae)
Eclectus parrots	*Eclectus roratus*
Species Commonly and Severely Affected	
Blue-fronted Amazon	*Amazona aestiva*
Blue-headed pionus	*Pionus menstruus*
Maximilian pionus	*Pionus maximiliani*
Dusky pionus	*Pinus fuscus*
Blue-crowned conure	*Aratinga acuticaudata*
Species Severely but Less Commonly Affected	
Black-masked lovebird	*Agapornis personata*
Fischer's lovebird	*Agapornis fischeri*
Peach-faced lovebird	*Agapornis roseicollis*
Golden-mantled rosella	*Platycercus eximius*
Double yellow-headed Amazon	*Amazona ochrocephala oratrix*
Yellow-naped Amazon	*Amazona ochrocephala auropalliata*
Yellow-crowned Amazon	*Amazona ochrocephala ochrocephalia*
White-crowned pionus	*Pionus senilis*
Plum-headed pionus	*Pionus tumultuosus*
Gray-cheeked parakeet	*Brotogeris pyrrhopterus*
Hawkhead parrot	*Deroptyus accipitrinus*
Other Species in Which Pox Has Been Observed	
Orange-winged Amazon	*Amazona amazonica*
Tucuman Amazon	*Amazona tucumana*
Mexican red-headed Amazon	*Amazona viridigenalis*
Lilac-crowned Amazon	*Amazona finschi*
Spectacled Amazon	*Amazona pretrei*
Mealy Amazon	*Amazona farinosa farinosa*
Yellow-faced Amazon	*Amazona xanthops*
Red-fronted macaw	*Ara rubrogenes*
Yellow-collared macaw	*Ara auricollis*
Severe macaw	*Ara severa*
Black-headed caique	*Pionites melanocephala*
White-bellied caique	*Pionites leucogaster*
Slenderbill conure	*Enicognathus leptorhynchus*
Mitred conure	*Aratinga mitrata*
Sun conure	*Aratinga solstitialis*
Jenday conure	*Aratinga jandaya*
Monk parakeet	*Myiopsitta monachus*
Blue-winged parrotlet	*Forpus xanthopterygius*
Green-rumped parrotlet	*Forpus passerinus*
Sierra parakeet	*Bolborhynchus aymara*
Patagonian conure	*Cyanoliseus patagonus*
Green-cheeked conure	*Pyrrhura molinae*
Maroon-bellied conure	*Pyrrhura rhodogaster*
Mealy rosella	*Platycercus adscitus*
Red-rumped parakeet	*Psephotus haematonotus*
Princess of Wales parakeet	*Polytelis alexandrae*
Tovi parakeet	*Brotogeris jugularis*
Tui parakeet	*Brotogeris sanctithomae*
Canary-winged parakeet	*Brotogeris versicolorus*

Amazon parrots, South American parakeets, and some miniature macaws.[5, 6]

In some species, this virus is highly fatal in both natural and experimental infections. This has been observed in three species of lovebirds: peach-faced (*Agapornis roseicollis*), black-masked (*Agapornis personata*), and Fischer's lovebirds (*Agapornis fischeri*).[5, 6, 12]

Species susceptibility may vary greatly within a genus. The blue-crowned conure (*Aratinga acuticaudata*) is commonly and severely affected, whereas the dusky conure (*Aratinga weddellii*), usually imported with the blue-crowned conure, is very resistant to natural and experimental infection. Orange-winged amazons (*Amazona amazonica*) are also much less susceptible to disease than are other members of the genus.[5, 6, 14]

All observed cases have been in family Psittacidae; no cases have been observed in family Loriidae or in family Cacatuidae.* Some birds appear to be fairly resistant to pox and rarely, if ever, develop clinical disease in spite of exposure. These include cockatoos (*Cacatua* sp.), cockatiels (*Nymphicus hollandicus*), African parrots (*Psittacus* sp. and *Poicephalus* sp.), large macaws (some *Ara* sp. and *Anodorhynchus hyacinthinus*), eclectus parrots (*Eclectus roratus*), and lories and lorikeets (*Eos* sp., *Pseudeos fuscata, Trichoglossus* sp., and *Lorius* sp.). Cockatiels show resistance to pox both in experimental and natural exposure.

Boosinger and coworkers vaccinated chickens with both fowl pox and pigeon pox vaccine and then challenged the birds with a virulent parrot pox isolate. The chickens developed cutaneous pox lesions after the challenge. Parrot pox isolates used as vaccines in chickens also failed to provide protection against the development of lesions when they were challenged with virulent fowl poxvirus.[2]

In field studies with parrots, fowl pox and pigeon pox vaccines have been ineffective in preventing the development of clinical disease in susceptible parrots exposed to natural and experimental challenges with parrot poxvirus.[6]

Canary Pox—Kikuth's Disease

Canary pox is a slowly spreading disease characterized by high mortality and a course of three to ten days. The incubation period established by experimental inoculation is three to 16 days, depending on the route of inoculation.[1, 3, 4, 12, 18]

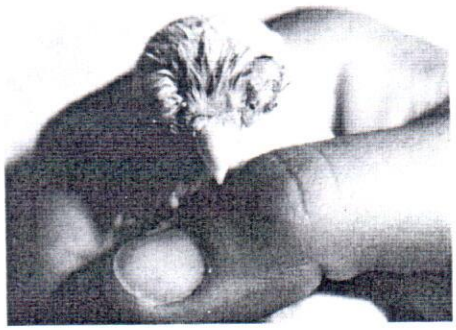

Figure 16–1. Bilateral pox lesions on the eyelids of a canary.

Two forms of canary pox are recognized: viremic and cutaneous.

Acute generalized illness occurs in the viremic form and mortality may reach 100 percent. Viremic birds exhibit dyspnea, diarrhea, ruffling, and depression; dyspnea increases before death. If the virus is extremely virulent, only acute respiratory distress and death may occur. If death occurs before the development of cutaneous lesions, postmortem lesions may include only congestion of the liver, heart, lungs, and meninges. Duration of the disease is usually five to six days. Recovery is rare.[4, 12, 18]

Onset of the cutaneous form is characterized by conjunctivitis, excessive lacrimation, scratching of the eyes and beak, edema of the lids, and soiled facial feathers. Yellowish proliferative lesions appear on the lids and spread to the commissure of the beak, the intermandibular space, and the skin of the head. Lesions commonly occur on the feet. Caseous lesions may be found in the mouth and esophagus.[4, 17, 18]

The lesions are proliferative and inflammatory. Scab formation follows and may be underrun with purulent exudate. In milder forms, skin lesions may spread over large portions of the body, and birds may linger for several weeks. Some mild strains may cause only lesions on the feet. These lesions may regress spontaneously unless secondary bacterial infections occur.[18]

Gerlach reported the development of pulmonary

*Taxonomic system used: Forshaw, J. M.: Parrots of the World. Garden City, N. Y.: Doubleday & Co. 1973.

Table 16–2. HOST SPECTRUM OF FOWL, TURKEY, CANARY, PIGEON, AND PARROT POX*

Virus	Host (Cutaneous Inoculation)				
	Chicken	*Turkey*	*Canary*	*Pigeon*	*Parrot*
Fowl	+G	+G	0	+	0
Turkey	+	+	0	+G	ND
Canary	+	+	+D	+G	ND
Pigeon	+	+	0	+G	0
Parrot	+	+	ND	0	+G

*Adapted from references 2, 6, 9, and 14.

Key: +, localized pox lesions; +G, localized pox lesions and/or generalized infection; +D, localized pox lesions and/or death; ND, no data; 0, no sign.

Figure 16–2. Canary pox lesion of the eyelid. The cornea and globe are unaffected but blindness occurs from visual obstruction.

adenocarcinomas in canaries that survive the viremic form of canary pox.[13]

Species other than canaries and their close relatives are not significantly affected by this pox. Other passerines housed with canaries will usually not become infected. The house sparrow has been shown to be susceptible to both experimental and natural infection with canary poxvirus and may be a reservoir. Transmission may be by direct contact with infected birds. Arthropod vectors may be important, but this has not been proved. If canaries are housed outdoors, they should be kept in screened cages to prevent infection by mosquitoes. All new arrivals should be quarantined to avoid introduction of an infected bird during the viral incubation period.[12]

Raptor Form

Avian pox in birds of prey is reported to be mild and self-limiting in most cases reported in the United States. A virulent form causing mortality and debilitating scars after recovery has been reported from the Mideast (United Arab Emirates and Pakistan). The disease produces classic cutaneous lesions on the feet, tarsometatarsal area, cere, and facial skin. Lesions may extend to the oral mucocutaneous junction and the hard palate. Affected birds are rarely systemically ill and continue to eat despite occasional extensive scabbing. Lesions may be pruritic and scratching may follow.

Pigeon Pox Form

Pigeon pox is a very important disease of wild and domestic pigeons. Racing pigeons are particularly at risk when they participate in races, since they may be infected when they are collected into groups and transported to a release site. The returning pigeon can then infect the entire loft. All ages are susceptible, but squabs are most severely affected.[10, 16]

Lesions develop four to 12 days after exposure to the virus. Proliferative lesions are most commonly observed on the face, mouth, beak, and eyelids. Occasionally, lesions are seen on the feet. Lesions may interfere with sight or feeding or may result in suffocation. Anorexia, wasting, and death follow in severe cases.[10, 16]

Trichomoniasis due to *Trichomonas columbae* may flare up and prove fatal. Pox lesions tend to be found in the keratinized areas of the mouth, whereas *Trichomonas* lesions are found in the pharyngeal region and appear as soft, yellowish growths.[10, 16]

Mortality rates are variable, but morbidity rates usually reach 90 percent; most birds in the loft become affected within a month after exposure. In mild cases, the scabs fall off within three weeks. Recovered birds are resistant to reinfection for at least one year. No passive resistance is passed on to squabs.[10, 16]

TREATMENT

Parrot Form

Treatment is nonspecific and is aimed at controlling secondary infections and providing supportive care. Lesions are treated topically with antiseptics, tinctures, and fat solvents in an attempt to dissolve the viral envelope.

Vitamin A has been clinically effective in decreasing severity of the infection if given before the appearance of lesions or during the very early stages of the disease. After the appearance of eye lesions, the vitamin A therapy is much less effective. In flock management of pox, weekly injections of vitamin A are given to large birds and vitamin A is given to small birds in their water and food. Doses of 10,000 to 25,000 units are given intramuscularly once weekly to a psittacine bird weighing 300 to 500 gm.[6, 8, 17]

Antibiotic therapy is often necessary in the treatment of secondary respiratory disease. Good results have been obtained with the use of gentamicin and tylosin given at the rate of 5 mg/lb each, either once or twice daily. This therapy is usually prolonged and may last several weeks; the medication is given for five days and withheld for two days, repeated as needed.[5, 6]

Antifungal therapy and microbial replacement reduce the incidence of secondary fungal infections. Nystatin may be given orally to individual birds; in flocks it may be used as a feed premix or mixed with soft foods.[5, 6]

Extensive scab formation on the lids often makes treatment of eye lesions difficult. These scabs should be left intact, if possible, in order to minimize damage to the lids. The scabs may be lifted at the lateral canthus just enough to apply medications between the scabbed lids and the cornea. Damage at the medial canthus may result in epiphora, and in order to minimize damage, this area should not be disturbed. An eyewash is prepared by mixing one-half ounce of 2 percent merbromin (Mercurochrome) to four ounces of eyewash solution or saline. Eye and skin lesions are washed daily with this solution. Chloramphenicol ointment (1 percent) is then applied to prevent secondary bacterial infections.[5, 6] Washing the lids with a dilute solution of baby

shampoo before scabs form will reduce the severity of scabbing.

Forced feeding of a balanced liquid diet by gavage may be necessary to offset wasting. Soft foods and fruits should be provided to increase consumption. Birds should be confined to small cages, and food and water supplies should be hung close to perches for easy access.

Canary Form

Commercial canary pox vaccines are available in Germany, Spain, and Italy. The use of commercial fowl or pigeon pox vaccines is not recommended. Results are irregular with pigeon pox, and fowl pox vaccines are ineffective.[18]

Treatment of canary pox is unlikely to be successful because of the rapidly fatal nature of the disease. It may be helpful to rub cutaneous lesions with a 2 percent aqueous solution of merbromin in 70 percent alcohol containing a trace of acetone.[8]

Raptor Form

Vaccination in raptors is not necessary because of spontaneous regression. Secondary bacterial infections of skin lesions may require antibiotic therapy.[7, 13]

Pigeon Form

A pigeon pox vaccine made for pigeons is available in the United States.* Commercially available virulent pigeon pox vaccines were developed for use in poultry and may result in severe lesions when used to vaccinate pigeons. Racing or show pigeons should be vaccinated annually before participation. Breeders should be vaccinated in the spring, before the breeding season. Squabs are vaccinated after the sixth week of life. Vaccine is administered by plucking a few feathers from the thigh and rubbing the vaccine into three or four follicles.[10, 16]

PREVENTION

After any case of pox is diagnosed in an established aviary, measures must be taken to avoid its spread to other birds and contamination of the premises. The virus is resistant to environmental conditions; however, most good virucidal disinfectants are effective if they remain in contact with hard surfaces for at least ten minutes. All wooden perches and nest boxes should be replaced. Pigeon lofts should be replaced or thoroughly disinfected and painted.

*Pigeon Pox Vaccine, Vineland Laboratories, Inc.

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