

A New Standard of Care for Aviculture

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Just as your physician cannot accurately determine your health status without conducting appropriate tests, veterinarians and aviculturists cannot tell if birds are infected with the Psittacine Beak and Feather Disease (PBFD) virus or polyomavirus without appropriate diagnostic tests. Bird enthusiasts now have the opportunity to determine whether birds are latently infected with the PBFD virus or if they are shedding polyomavirus. The DNA probe tests developed by the Psittacine Disease Research Group at the University of Georgia College of Veterinary Medicine are currently available in the United States through Avian Research Associates, 100 Techne Center, Suite 101, Milford, OH 45150. These tests will provide the avi-

cultural community with the knowledge necessary to manage two of the most contagious and devastating viral diseases of psittacine birds.

To control the spread of PBFD virus and polyomavirus, and to improve the professional standard of aviculture, all birds should have a documentable medical history of testing (traceable record) for these diseases, by which anyone who comes into possession of a bird can review its history to know that it is a relatively "safe bird." Pet shop owners, bird dealers, breeders and veterinarians need to protect themselves from accusations that they raised or sold a diseased bird. (Table 1)

The PBFD test can be used to screen blood for the presence of PBFD virus before birds develop obvious clinical

signs. The polyomavirus test can be used to determine if birds are shedding this virus. Both the PBFD virus and the polyomavirus tests can be used to screen walls, caging, air circulating ducts and equipment, in the home or hospital, to determine if one of these viruses is contaminating a bird's environment.

These tests are inexpensive (\$25 range), particularly when one considers the devastation of losing a special pet, or suffering with a nursery or pet shop outbreak caused by PBFD virus or polyomavirus that could have been prevented. These tests will provide the avian community with the best methods for controlling these viruses until effective vaccines are available. These tests are extremely sensitive and specific and results should be available within two weeks of being received in the laboratory.

If you are a pet bird owner, it is in your pet's best interest to know its status with respect to these two viruses. All psittacine birds should be tested to determine if they are shedding polyomavirus or are infected with PBFD virus. The species of psittacine birds that have currently been shown to be susceptible to PBFD virus are listed in Table 2. Both PBFD virus and polyomavirus can be transmitted in feather or fecal dust which you can carry on your clothes to other birds in your home, to a friend's home, to a bird show or to a pet shop. Not knowing if your birds are infected with one of these two viruses places any bird that you may contact in jeopardy.

If you are a breeder, it is critical that you have your adult birds tested for PBFD virus and polyomavirus to pre-

TABLE 1
Controlling PBFD Virus and Polyomavirus

If you are a pet bird owner

- Use DNA probes to test your pet birds
- Use DNA probes to test any new birds that you add to your avian family
- If an outbreak occurs, use DNA probes to test your cleaning effort

If you are a breeder

- Use DNA probes to test your breeders
- Use DNA probes to test any adult or baby before it is shipped from your facility
- Use DNA probes to test any new birds during the post-purchase quarantine period
- If an outbreak occurs, use DNA probes to test your cleaning effort

If you are a pet shop owner

- Use DNA probes to test all birds before they are sold
 - Only deal with suppliers who test their birds before shipping
 - Use DNA probes to test your shop twice a month to detect any virus contamination
-

vent epidemic outbreaks of these diseases in your nursery. Every bird that is shipped from your facility should be tested to make certain that it is not latently infected with PBFD virus or shedding polyomavirus. This will provide you with a documented status report for all your birds should one of them be involved in an outbreak. If your birds have *not* been tested, guess who may be left holding the bag (or picking up the bill) in the event that one of your birds is later diagnosed with one of these viruses?

Unfortunately, there will always be a market for substandard birds provided by substandard breeders. Not testing a bird before it is shipped from your facility will place you in an untenable position with respect to the quality of your birds. Absolutely no bird should be added to your breeding collection that is not tested for these two viruses during their post-purchase quarantine period.

If you are a pet shop owner, you should insist that every bird you purchase be tested for PBFD virus and polyomavirus, and it would be prudent to retest a bird before it is transferred to a customer's home. This testing will provide documentation of the bird's health status, with respect to these two diseases, at the time of transfer offering you some protection should a bird become infected with one of these viruses after leaving your pet shop. Pet shop owners are currently held responsible (often sued) for PBFD virus infections that appear in birds months after they leave their shop. As a shop owner, you now have an inexpensive and objective method for establishing the condition of birds as they leave your shop. In addition to testing the birds before leaving your shop, your avian veterinarian can also test your building and equipment twice a month to make certain your shop is not contaminated with one of these viruses.

If you are purchasing a bird from any source, insist that you be given a three week time period in which to have your avian veterinarian test the bird for PBFD virus and polyomavirus. Also insist that your veterinarian receive a copy of the breeder's and shop owner's test results on the bird you are buying. If a bird supplier is not willing to give you this period in which to test the bird, you should consider changing suppliers.

If you have other birds, post-purchase testing is particularly critical to ensure that a new addition to your avian family does not cause a disease outbreak. If you have the bird tested and it is positive, then you know that the bird was infected from its source and the bird should be returned. If you choose not to test a new bird, then any future health problems caused by PBFD virus or polyomavirus will be your responsibility. Testing is an effective way to insure that your pet bird does not have PBFD virus and is not shedding polyomavirus.

Use of DNA Probes to Detect PBFD Virus

The recommended sample to submit for detecting active (feather abnormalities) or subclinical (no feather abnormalities) PBFD virus infections is whole anticoagulated blood (0.1 to 1.0 mls in heparin). A positive test in a bird that has feather abnormalities suggests that the bird has an active PBFD viral infection. A positive blood test in a bird that does not have feather abnormalities may indicate that the bird is latently infected or that it recently has been exposed to the PBFD virus. A bird that tests positive and has no feather abnormalities should be retested in 90 days. If the bird is still positive, then it should be considered as latently infected. A negative test result means that PBFD virus was not detected in the submitted sample.

A pet bird that is diagnosed with PBFD virus or that is a PBFD virus carrier can live a long life when provided a stress free environment and supportive medical care. These birds should be restricted from contact with other susceptible birds, particularly neonates. PBFD virus-infected birds should not be maintained in breeding facilities, pet shops or where they may expose susceptible neonates or adults.

Use of DNA Probes to Detect Polyomavirus

Polyomaviral DNA probes can be used to detect polyomavirus in cloacal swabs of birds that are actively shedding the virus. In a breeding aviary, swabs of feces from each bird can be used as an initial screening test in place of a cloacal swab. Breeding birds should be screened at least once

each year. However, a better practice would be to test birds twice per year (before and after breeding season) to detect intermittent viral shedders.

A positive polyomavirus test result means that polyomavirus was detected in the submitted sample. A negative polyomavirus test result means that polyomavirus was not detected in the submitted sample. A bird that is shedding polyomavirus could be maintained as a pet if it does not expose other birds, particularly neonates, to the virus. Breeding birds shedding polyomavirus should be separated from the remainder of the collection and then offspring raised separately from birds that test negative.

Detecting a Contaminated Environment

You can determine if cleaning efforts following an outbreak of either of these viruses are sufficient by testing a swab of air ducts, carpets, caging or any dusty area to see if they are contaminated with PBFD virus or polyomavirus. Your veterinarian can do the same to ensure that their clinic is

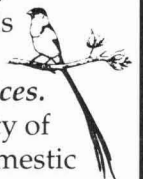
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not contaminated with one of these viruses. You should encourage your avian veterinarian to test the hospital examination and treatment areas frequently to make certain that your birds are not exposed to lingering PBFD virus or polyomavirus.

An Overview of PBFD Virus

Since its initial description in the mid-1970s, Psittacine Beak and Feather Disease (PBFD) has been reported in many species of captive and free-ranging Old World psittacine birds.¹⁻¹² However, PBFD virus is not just a disease of cockatoos, African Grey Parrots and Eclectus Parrots. The virus is expanding its host range and is being reported in species of psittacine birds that were once thought to be resistant to the disease. Included in the expanding list of susceptible birds are several New World psittaciformes such as Amazon parrots, macaws and pionus parrots.^{8,11-13} The species of birds currently known to be susceptible to PBFD virus are included in Table 2. How many of your birds are on the list?

What Causes PBFD?

Through the support of bird owners from around the world, our research group has been able to expand on preliminary information collected by infectious disease researchers in Australia to show that PBFD is caused by a highly infectious virus.^{6,9,11,14} Comparative studies of PBFD virus recovered from various genera of psittacine birds have indicated that a similar virus infects a wide range of psittaciformes.^{9,11-14,16,17} For example, virus recovered from an Umbrella Cockatoo is similar to the virus recovered from an African Grey Parrot, budgerigar, Eclectus Parrot, lovebird and other species of cockatoos. DNA probes developed to document the presence of PBFD virus have been found to successfully detect the virus in all affected psittacine birds that have been tested, indicating that the virus is similar in each affected species. Based on its unique characteristics, the PBFD virus has been placed in a new family of viruses (suggested name Circodnaviridae) that represents the smallest animal viruses that have been described.¹⁵

How is PBFD Clinically Recognized?

The first clinical sign of PBFD (birds

TABLE 2
Species of Psittacine Birds
Currently Shown to be Susceptible
to PBFD Virus

Sulphur-crested Cockatoo (<i>Cacatua galerita</i>)
Galah (<i>Eolophus roseicapilla</i>)
Long-billed Corella (<i>C. tenuirostris</i>)
Cockatiel (<i>Nymphicus hollandicus</i>)
Western Rosella (<i>Platycercus icterotis</i>)
Malee Ringneck Parakeet (<i>B. barnardi</i>)
Red-rumped Parrot (<i>Psephotus haemototus</i>)
Eclectus Parrot (<i>Eclectus roratus</i>)
Peach-faced Lovebird (<i>Agapornis roseicollis</i>)
Fisher's Lovebird (<i>A. fischeri</i>)
King Parrot (<i>Alisterus scapularis</i>)
Umbrella Cockatoo (<i>C. alba</i>)
Triton Cockatoo (<i>C. triton</i>)
Goffin's Cockatoo (<i>C. goffini</i>)
Blue-fronted Amazon Parrot (<i>Amazona aestiva</i>)
Red-vented Cockatoo (<i>C. haematuropygia</i>)
African Grey Parrot (<i>Psittacus erithacus</i>)
Black Palm Cockatoo (<i>Probosciger aterrimus</i>)
Gang-gang Cockatoo (<i>Callocephalon fimbriatum</i>)
Rose-ringed Parakeet (<i>Psittacula krameri</i>)
Golden-shouldered Parrot (<i>Psephotus chrysopterygius</i>)
Jandaya Conure (<i>Aratinga auricapilla</i>)
Pionus Parrot (<i>Pionus maximiliani</i>)
Major Mitchell's Cockatoo (<i>C. leadbeateri</i>)
Little Corella (<i>C. sanguinea</i>)
Budgerigar (<i>Melopsittacus undulatus</i>)
Rainbow Lorikeet (<i>T. haematodus</i>)
Hooded Parrot (<i>Psephotus dissimilis</i>)
Port Lincoln Parrot (<i>B. zonarius</i>)
Bourke Parrot (<i>Neophema bourkii</i>)
Princess Parrot (<i>Polytelis alexandrae</i>)
Nyassa Lovebird (<i>A. lilianae</i>)
Masked Lovebird (<i>A. personata</i>)
Moluccan Cockatoo (<i>C. moluccensis</i>)
Indian Ringneck Parakeet (<i>P. manillensis</i>)
Citron Cockatoo (<i>C. citrinocristata</i>)
Vasa Parrot (<i>Coracopsis vasa</i>)
Red-lored Amazon (<i>A. autumnalis</i>)
Senegal Parrot (<i>Poicephalus senegalus</i>)
Meyer's Parrot (<i>P. meyeri</i>)
Red-bellied Parrot (<i>Poicephalus rufiventris</i>)
Scarlet Macaw (<i>Ara macao</i>)
Pale-headed Rosella (<i>Platycercus adscitus</i>)
Northern Rosella (<i>Platycercus venustus</i>)
Green-winged Macaw (<i>Ara chloroptera</i>)

may be infected for months before developing clinical signs) is the appearance of necrotic, abnormally formed feathers. The type of feathers that are initially involved depends on the stage of molt when the clinical signs of disease first appear. In young birds, all of the feather tracts may be affected during a one-week period, whereas in older birds, the disease is more prolonged, with progressive feather changes during ensuing molts. If beak lesions develop, they may include palatine necrosis, progressive elongation, and transverse or longitudinal fractures.^{1,4,6,7,13,14}

Infections in young birds may be characterized by fractures, bending, bleeding or premature shedding of developing feathers or may manifest as depression, anorexia, crop stasis and diarrhea with minimal feather abnormalities followed by death in one to two weeks.^{1,3,6,14} A diagnosis of acute PBFD may be missed unless a thorough necropsy is performed on a young bird which dies suddenly (the most accurate diagnosis is achieved by sending a blood sample for testing).

Infected African Grey Parrot and cockatoo chicks have been found to develop normally three to four weeks after exposure to the virus, at which time they become depressed and begin to regurgitate intermittently. Within three days of becoming depressed, affected birds start to lose powder-down and contour feathers. Several of the primary and secondary feather shafts appear dark red-brown and become loose in their follicles. Over the next five days, affected birds continue to lose contour, flight, tail and crest feathers followed by death.¹⁴

Feather loss associated with the chronic form of PBFD is basically symmetrical, and normal plumage is progressively replaced with dystrophic feathers during a molt. Most pictures of featherless birds illustrate the chronic form of PBFD which has progressed for years. Some birds die shortly after the first indication of malformed feathers; others may live for several years in a featherless state.

While PBFD is reported most commonly in birds less than three years of age, the disease can also develop in older adult birds that have previously shown no signs of feather abnormalities. We have seen many birds that



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were more than ten years old before they developed any signs of PBFD.

How is PBFD Diagnosed?

One of the best ways for a bird owner or breeder to have problems with PBFD virus is for them to develop an attitude that they can tell by a bird's feather condition if it is infected with this virus. Attempts to determine if a bird does or does not have PBFD based on the appearance of feather lesions, particularly on the presence or absence of powder-down, is of *no* value. The best and most sensitive test for confirming that a bird is either clinically affected (feather lesions) or subclinically infected (no feather lesions) with the PBFD virus is the use of viral specific DNA probes to detect this virus in blood. This test can detect birds which are latently infected months before they develop feather changes.

PBFD should be suspected in *any* psittacine bird with progressive feather loss in which malformed feathers can be identified. PBFD can only be confirmed through laboratory testing. A feather loss problem in budgerigars clinically favoring PBFD is often referred to as French molt. Interestingly, French molt may be caused by either the polyomavirus (papovavirus, budgerigar fledgling disease) or by the PBFD virus.^{1,3,13,18}

How is the PBFD Virus Transmitted?

PBFD virus is shed from an infected bird in feces, crop excretions and in feather dust. One of the critical pieces of information that all bird owners and veterinarians should understand is how the PBFD virus is being transmitted among birds. Armed with this information, one can implement sound testing and hygiene practices which will help to reduce the chances of a PBFD virus outbreak. The recovery of PBFD virus in the feces and crops of diseased birds suggests that contaminated excretions and secretions from infected birds may be involved in disease transmission.¹⁹ We also know that an infected hen may pass the virus to her offspring through the egg. Thus, attempts to prevent PBFD virus infections through artificial incubation are futile. Testing to detect latently infected birds is the key to preventing infections.

Our most important finding about

the routes of virus transmission was the recovery of high concentrations of the virus from feather dust in a room where PBFD birds were being housed. Given the ease with which feather dust can be dispersed both through natural air flow and through contact with clothing, nets, bird carriers, food dishes, or insects, we feel that contaminated feather dust is a major method for transmission and environmental persistence of the virus.¹⁹ You can determine if cleaning efforts following an outbreak are sufficient by testing a swab of air ducts, carpets, caging or any dusty area to see if they are contaminated with PBFD virus.

How Long can the PBFD Virus Remain Infective?

The environmental stability of the PBFD virus is unknown, but it is suspected to be very stable in the environment. Some viruses can live for long periods in the environment, while other viruses can live only minutes outside of the host. Typically, it is the presence of a lipoprotein envelope surrounding some viruses that determines how long a virus can persist in the environment. Viruses that have an envelope do not normally survive long outside the host, and they are sensitive to most disinfectants. Viruses that do not have an envelope tend to be more stable in the environment and are resistant to many disinfectants. Unfortunately, PBFD virus does not have an envelope, and is probably very stable in the environment, resistant to many disinfectants and can remain infective for long periods of time.

The chicken anemia virus, which is related to the PBFD virus, has been found to be environmentally stable, and infectivity remains unchanged when the virus is heated to 60°C for one hour and following treatment with detergents, enzymes and many commercial disinfectants.^{15,20} It would be prudent to consider that the PBFD virus stability is similar to that described for the chicken anemia virus.

The PBFD virus is extremely contagious, particularly to young birds. PBFD positive birds should not be maintained where exposure can occur to psittacine babies or to endangered species. Exposure of neonates to the virus in the nursery can cause devas-



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tating losses. We have investigated nursery outbreaks where up to 40 cockatoo babies have developed PBFD from a single exposure source.

What is the Incubation Period of PBFD Virus?

The incubation period for PBFD virus has been found to vary among different hosts. Galah chicks infected with PBFD virus have been reported to develop clinical signs of PBFD approximately four weeks after infection.⁶ African Grey Parrot chicks infected at three to eight days of age became depressed at 30 days of age and developed progressive feather dystrophy from 33 to 44 days of age. Umbrella Cockatoo chicks infected at three to eight days of age became depressed at 40 days of age and developed progressive feather dystrophy at 42 to 47 days of age.¹⁴ The incubation period in maternally transmitted infections has been found to vary from 32 to 80 days of age. These findings suggest a minimum incubation period for the development of feather lesions of 21 to 24 days. The maximum incubation period is unknown. The virus can be found in the blood of infected birds weeks to months before feather lesions develop.

What's New With Developing a Vaccine?

The ultimate control of PBFD virus will depend on the licensing of an effective vaccine. Our final phase of work is to develop an easily produced vaccine which can be used to help bird owners prevent this disease. We have taken the first step toward this goal by vaccinating birds with an experimental, killed PBFD virus vaccine.

Early in our PBFD virus investigations, we were able to show that some birds which are exposed to the PBFD virus but remain clinically normal, develop antibody titers to the virus. This can be viewed as a "natural vaccination" process.¹⁶ We used this information to design a study to determine if birds could be experimentally vaccinated and if vaccinated hens produce chicks that were resistant to PBFD virus. What we found was very exciting for the bird owner. We were able to show that an experimental vaccine induced antibody titers in vaccinated adults. Further, we found that vaccinated hens produced chicks that

were at least temporarily resistant to PBFD virus infections. This work suggests that a vaccination program will be effective in preventing this disease.¹⁴ Our research group is currently working on an effective vaccine that can be licensed for widespread use by the avicultural community.

Until a Vaccine is Available, How Can You Prevent PBFD Virus Infections?

Currently, there is no effective therapy for PBFD virus and with its viral etiology no effective cure should be expected. The ability of the avian community to prevent PBFD virus infections will require the involvement of *every* individual and organization interested in avian health and the future propagation of psittacine birds, both in the wild and in captivity. Until we have a licensed vaccine available, there are several things you can do to reduce the chances of your birds contracting PBFD. The key to these suggestions is: **REDUCE EXPOSURE.** *Have* all of your birds tested to make certain they are not latently infected with PBFD virus. *Have* any bird that is being added to your aviary tested for PBFD virus during its quarantine period. *Have* any bird that you are shipping tested before it leaves your aviary. *Always* avoid contact between birds from different collections and *do not* mix neonates from several sources in the psittacine nursery. Since PBFD is caused by a virus that can be shed into the environment and may survive for prolonged periods, do not maintain PBFD positive birds in aviary collections.

An Overview of Polyomavirus (Papovavirus)

Using the word papovavirus to describe the virus that causes neonatal death in psittacine birds is a misnomer. There are actually two viral groups within the papovaviridae family: 1) papillomavirus, which is generally associated with benign skin tumors (warts) in finches and African Grey Parrots; and 2) budgerigar fledgling disease or papovavirus of larger psittacines which will be referred to as "polyomavirus".¹²¹⁻³¹

This virus has done more to damage the relationship of breeders, pet shop owners and clients than any other disease we face as bird enthusiasts. Outbreaks create distrust, conflict and

segregate individuals who should be combining resources in order to improve the health and happiness of our avian pets.

The first generalized infection associated with a polyomavirus was described in young psittacine birds and was called budgerigar fledgling disease.^{21,22,24,25} Unfortunately, the virus is not limited to budgies, and may cause substantial losses of larger psittacine neonates.²⁷⁻³¹

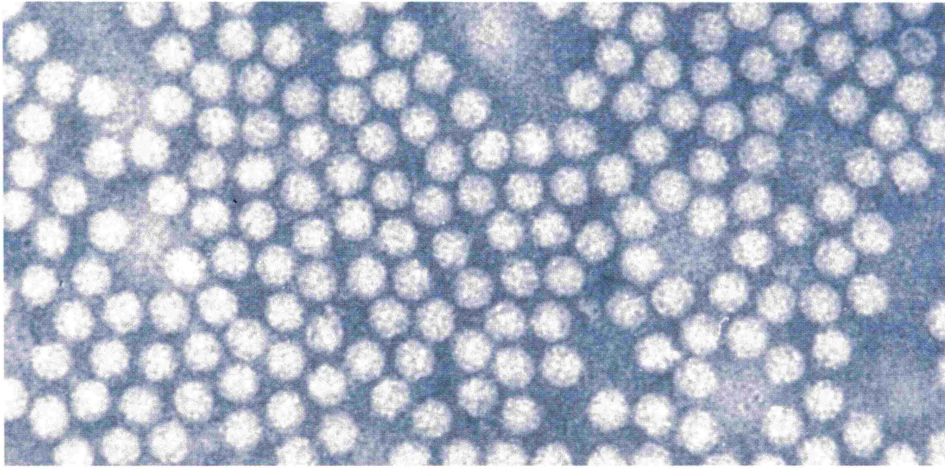
The clinical presentation, distribution of lesions and method of diagnosing polyomavirus in budgerigars is completely different from the clinical presentation, distribution of lesions and diagnostic methods for large psittacine birds.

Infected budgerigar neonates typically develop abdominal distension, subcutaneous hemorrhage, tremors of the head and neck, and ataxia. Survivors may exhibit symmetrical feather abnormalities characterized by dystrophic primary and tail feathers, lack of down feathers on the back and abdomen and lack of filoplumes on the head and neck. When feather lesions are present, the disease is often referred to as French molt.

In larger psittacine birds, polyomavirus infections may cause a peracute death with no premonitory signs or death 24 to 48 hours after developing clinical signs including depression and anorexia, delayed crop emptying, regurgitation, weight loss, subcutaneous hemorrhages and diarrhea. Infections may occur in both parent and hand-raised babies and clinical signs are most common at the time of weaning.²⁷⁻³¹ Occasionally, adult birds may die acutely with a polyomavirus infection.³¹ The feather abnormalities that are relatively common with polyomavirus infections in budgerigars are described less frequently in other psittacine species.

How is Polyomavirus Transmitted?

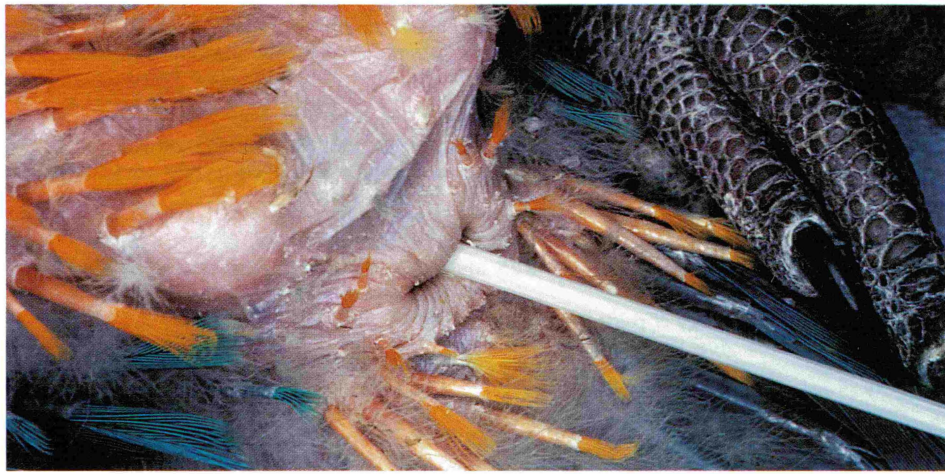
The factors involved in polyomavirus infections are not fully understood. One of the formidable problems which occurs with polyomavirus is that normal adults and neonates from infected parents can act as polyomavirus carriers. These birds intermittently shed the virus and are thought to be responsible for the persistence, transmission and spread of the virus through various avian popu-



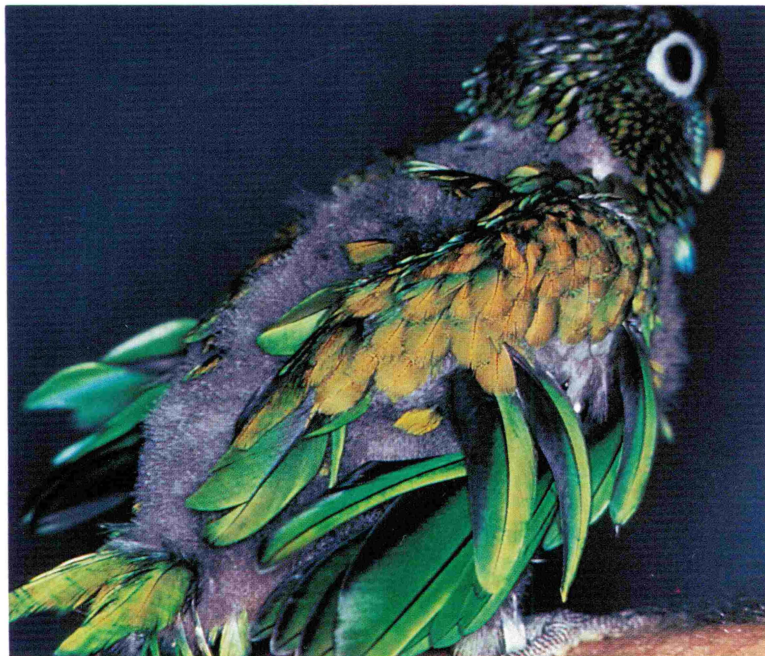
The PBFD virus is the smallest pathogenic animal virus that has been described. This picture was made of a virus preparation containing about 1 billion viral particles. Each individual virus particle is theoretically capable of producing disease. The virus demonstrated in this picture was recovered by vacuuming the walls in a room where PBFD positive birds were being housed.



Few bird breeders, pet shop owners or bird owners would pass up a Little Corella that appeared as healthy as this bird. However, this bird has PBFD virus that was diagnosed using the DNA probe test. The bird was found to be PBFD virus positive using the blood test two months before any feather changes could be detected.



A simple cloacal swab can be used to detect birds that are actively shedding polyomavirus.



PBFD virus infections can cause dramatic feather loss in young psittacine birds. This Pionus Parrot neonate was completely normal several weeks before this picture was taken. The baby was infected when the breeder introduced birds from another collection into the nursery without testing for PBFD virus.



The African Grey Parrot with normal feathers was experimentally vaccinated for PBFD and was resistant to infection. In this picture, the experimentally vaccinated bird is standing next to a PBFD positive African Grey Parrot the same age. This contrast demonstrates the degree of feather damage induced by the PBFD virus in young birds.

lations. Some asymptomatic adults produce persistently infected young while others have neonates that intermittently have clinical signs of disease.²⁷⁻³³ Interestingly, it is rarely the birds which die from polyomavirus that are the source of the virus, but rather it is the birds which remain normal that are the likely carriers of the virus and are responsible for introducing it into a nursery or pet shop.

A carrier can shed the virus while showing no signs of disease, fatally infecting any susceptible birds that it comes in contact with. Experimental data and observation in field cases of the disease suggest that viral transmission may occur through feces, urine, respiratory secretions and in feather dust. The virus may also be transmitted to young directly in the egg. Thus, attempts to prevent infections through artificial incubation are useless.^{21,22,24-33}

How is a Polyomavirus Infection Diagnosed?

Several antibody tests have been used to demonstrate polyomavirus antibodies from infected birds. Subclinical carriers of the polyomavirus have been previously thought to maintain persistent antibody titers in serial serologic assays.^{18,32,33} We have developed a viral-specific DNA probe that can be used to detect shedders of the polyomavirus, and have found that there is no correlation between antibody titers and the shedding of this virus.^{18,31,35} The DNA probe test can be used to manage polyomavirus by allowing the bird enthusiast to screen their birds for subclinical shedders of the polyomavirus simply by using a cloacal swab.

Can Polyomavirus Infections Be Prevented with Vaccination?

Macaws experimentally vaccinated with an experimental polyomavirus vaccine were found to seroconvert and were protected from subsequent infection. These findings are certainly encouraging, suggesting that an effective polyomavirus vaccine can be developed. Investigations are currently underway to further determine the effectiveness of this experimental vaccine in different psittacine birds.³⁹

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