Avian Chlamydiosis

(Psittacosis, Ornithosis, Parrot Fever)

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Avian chlamydiosis is a systemic, bacterial infection caused by *Chlamydia psittaci*. Among poultry, turkeys and ducks are more susceptible than chickens. The disease varies from asymptomatic to high morbidity and mortality. Clinical signs are nonspecific and include anorexia, apathy, drop in egg production, diarrhea, ocular discharge, and respiratory disease. Diagnosis is achieved using serology, culture, and/or PCR. Treatment is with antibiotics such as tetracyclines. It is a zoonosis referred to as psittacosis, parrot fever, or ornithosis, which can cause serious health problems in humans (eg, pneumonia).

Avian chlamydiosis can be an inapparent subclinical infection or acute, subacute, or chronic disease of wild and domestic birds characterized by respiratory, digestive, or systemic infection. Infections occur worldwide and have been identified in at least 465 avian species, particularly caged birds (primarily psittacines), colonial nesting birds (eg, egrets, herons), ratites, raptors, and poultry. **Among domestic species, turkeys, ducks, and pigeons are most often affected.** The disease is a significant cause of economic loss and human exposure in many parts of the world.

Etiology and Epidemiology

Chlamydia psittaci is an obligate intracellular bacterium. Eight avian serotypes are recognized, based on binding of monoclonal antibodies to epitopes of the major outer membrane protein; of these, six (A–F) infect avian species and are distinct from mammalian *Chlamydia* serotypes. Strains of *C psittaci* have been classified using genetic differences in the *omp1* gene into nine genotypes. Seven of these (A, B, C, D, E, F, and E/B) are found in avian species and usually correspond to the equivalent serotype. Six additional genotypes were described later.

Each avian serotype/genotype tends to be associated with certain types of birds (see Table: Associations between Avian Genotypes of *Chlamydia psittaci* and Types of Birds). Serotypes A and D are highly virulent for turkeys and can cause mortality of ≥30%. Serotypes B and E are most frequently recovered from wild birds. Avian serotypes can infect people (particularly A, B, and E/B) and other mammals.

Two new *Chlamydiaceae* species have been identified in the past decade and have a worldwide distribution; *C gallinacea* in chickens and guinea fowls and *C avium* in pigeons and psittacines. The pathogenic and zoonotic potential of these new *Chlamydia* species remains to be determined.

Associations between Avian Genotypes of *Chlamydia psittaci* and Types of Birds

	A	B	C	D	E	E/B	F
Psittacines	++	+			+		+
Pigeons, doves	+	++			++	+	
Waterfowl	+	+	++		+	++	
Turkeys	+	+	+	++	+	+	+
Chicken		++	+	++	+	+	
Passerines	+	++					
Ratites					++		
Wild birds		++			++		

++ = Genotype most commonly associated with this bird species or group.
+ = Genotype less commonly associated with this bird species or group.

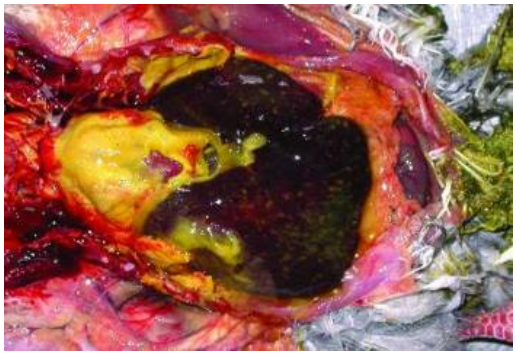
The main mode of **transmission is by the fecal-oral route or by inhalation.** Respiratory discharge or feces from infected birds contain elementary bodies that are resistant to drying and can remain infective for several months when protected by organic debris (eg, litter and feces). Airborne particles and dust spread the organism.
After inhalation or ingestion, elementary bodies attach to mucosal epithelial cells and are internalized by endocytosis. Elementary bodies within endosomes in the cell cytoplasm inhibit phagolysosome formation and differentiate into metabolically active, noninfectious reticulate bodies that divide and multiply by binary fission, eventually forming numerous infectious, metabolically inactive elementary bodies. Newly formed elementary bodies are released from the host cell by lysis. The incubation period is typically 3–10 days but may be up to several weeks in older birds or after low exposure. Host and microbial factors, route and intensity of exposure, and treatment determine clinical course. Arthropod-borne transmission by blood-sucking ectoparasites is possible. Vertical transmission has been documented in several bird species, including turkeys, chickens, and ducks.
Possible sources of *C psittaci* include:

- contact with infected sick birds or asymptomatic carriers
- vertical transmission from infected birds
- infected mammals
- infected arthropods
- contaminated environments

Stressors (eg, transport, crowding, breeding, cold or wet weather, dietary changes, or reduced food availability) and concurrent infections, especially those causing immunosuppression, can initiate shedding in latently infected birds and cause recurrence of clinical disease. In turkeys, *C psittaci* and *Ornithobacterium rhinotracheale* infection are often concurrent. Carriers often shed the organism intermittently for extended periods. Persistence of *C psittaci* in the nasal glands of chronically infected birds may be an important source of organisms.
Longterm inapparent infections lasting for months to years are common and are considered the normal *Chlamydia*-host relationship. The prevalence of infection varies considerably between species and by geographic location. Infection is endemic in commercial turkey flocks; no clinical signs or mild respiratory signs and low mortality are the common presentations. Outbreaks are rare. Although chickens are relatively resistant to clinical disease, asymptomatic infection is frequent. Recently, *C gallinacea* has been shown to be endemic in chickens. Wild birds are often seropositive for *C psittaci*.

Clinical Findings and Lesions

Acute chlamydiosis, pigeon



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Chlamydiosis, lorikeet

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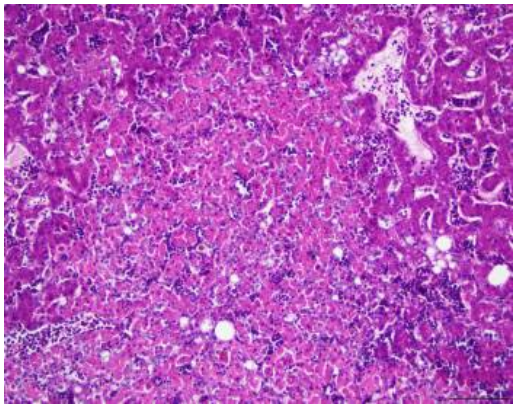
Chlamydiosis, liver, cockatiel



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Severity of clinical signs and lesions of avian chlamydiosis depends on the virulence of the organism, infectious dose, stress factors, and susceptibility of the bird species; asymptomatic infections are common. **Signs include:**

- nasal and ocular discharge
- conjunctivitis
- sinusitis
- green to yellow-green droppings
- fever
- inactivity
- ruffled feathers
- weakness
- inappetence
- weight loss
- drop in egg production

Respiratory signs predominate in turkeys and chickens. Watery diarrhea is often present in ducks. Young birds are more likely to develop severe disease.

Clinical pathology test results vary with the organs most affected and severity of the disease. Hematologic changes most often present are anemia and leukocytosis with heterophilia and monocytosis. Plasma bile acids, AST, LDH, and uric acid may be increased. A radiograph or a laparoscopy may reveal an enlarged liver and spleen and thickened air sacs.

Necropsy findings in acute infections of avian chlamydiosis include:

- serofibrinous polyserositis (airsacculitis, pericarditis, perihepatitis, peritonitis)
- bronchopneumonia
- hepatic necrosis
- hepatomegaly
- splenomegaly

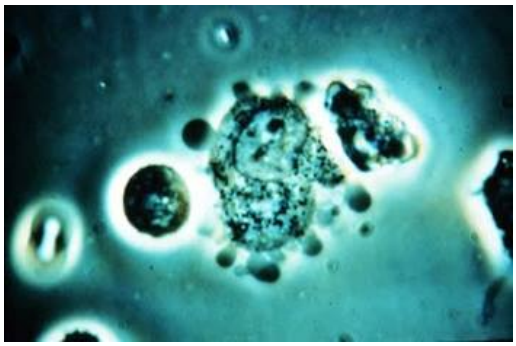
Similar lesions are seen in other systemic bacterial infections and are not specific for avian chlamydiosis. Small granular, basophilic intracytoplasmic bacterial inclusions might be observed in multiple cell types (eg, epithelial cells, macrophages) on cytology and histopathology. In chronic infections, enlargement and pale spleen or liver may be noted. Necrosis and bacterial inclusions are not seen. Lesions are usually absent in latently infected birds, even though *C psittaci* is often being shed.

Diagnosis

- For flocks, serologic testing, necropsy, and PCR
- For individuals, demonstration of shedding of the organism by PCR or culture, a rise in antibody titers, or a combination of serologic test and PCR test or culture

Because of the variety of clinical presentations and common occurrence of latently infected carriers, no single diagnostic test can reliably determine infection. Procedures to detect the organism or antibodies are used. In general, the more acute the disease, the greater the number of infective organisms and the easier it is to make a diagnosis. When birds are acutely ill, clinical findings, including hematology, clinical chemistries, and radiology or typical gross lesions, are adequate for a tentative diagnosis.

Chlamydia psittaci, elementary bodies



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The combination of a serologic and an antigen detection test, PCR, or culture, is a practical diagnostic scheme to confirm chlamydiosis. In live individual birds, the preferred sample for bacterial culture or PCR are conjunctival, choanal, and cloacal swabs. Multiple samples collected throughout 3–5 days are recommended for detection of

interpretation of titers from single serum samples is difficult. A 4-fold increase in titers between paired acute and convalescent samples is diagnostic, and high titers in a majority of samples from several birds in a population are sufficient for a presumptive diagnosis.

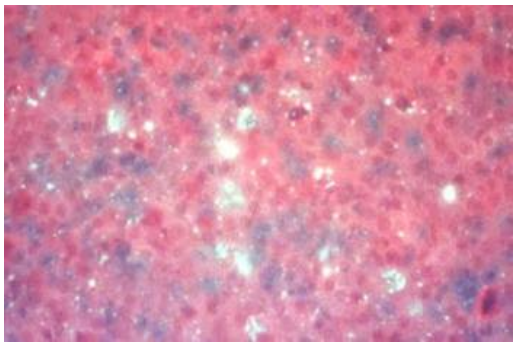
Serologic methods include direct and modified direct complement fixation, elementary body agglutination, antibody ELISA, and indirect immunofluorescence. The elementary body agglutination test detects IgM and is useful to determine recent infection. The complement fixation methods are more sensitive than agglutination methods. High antibody titers may persist after treatment and complicate evaluation of subsequent tests.

The discovery of other *Chlamydiaceae* species such as *C gallinacea* in chickens and *C avium* in pigeons and psittacines may complicate the interpretation of serologic tests because antibodies detected are likely not specific for *C psittaci.*

Antigen detection methods include immunohistochemistry (eg, immunofluorescence, immunoperoxidase), and ELISA. The specificity and sensitivity of ELISA kits developed for detection of *Chlamydia trachomatis* in people when used for detection of *C psittaci* is uncertain. They appear to have good specificity but somewhat low sensitivity, and they are not a recommended assay. These kits are most useful when birds are clinically ill.

PCR is the most sensitive and specific test. *Chlamydiaceae* spp and *C psittaci* PCRs are available. Results may differ between laboratories because of the lack of standardized PCR primers and laboratory method variations. False-positive results are a concern with PCR, because cross-contamination can occur relatively easily.

Chlamydia psittaci, fluorescent antibodies



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Gross and histologic lesions are not pathognomonic. The organism can sometimes be identified in impression smears of affected tissues (eg, liver, spleen, and lung). Chlamydiae stain purple with Giemsa and red with Macchiavello and Gimenez stains. Immunohistochemistry is more sensitive than the histochemical stains to detect bacteria in tissue, but cross reactivity with nonchlamydial organisms can occur. In situ hybridization and electron microscopy can also be used to confirm the diagnosis.
Isolation and identification of *C psittaci* can be performed in chick embryo or cell cultures (eg, BGM, L929, Vero) at a qualified laboratory. Cloacal, choanal, oropharyngeal, conjunctival, or fecal swabs (in a special *Chlamydia* transport media) from live birds or tissues (liver and spleen preferred) from dead birds should be refrigerated and submitted promptly to the laboratory. Freezing, drying, improper handling, and improper transport media can affect viability. The laboratory should be contacted for directions to submit samples.
Concurrent infections with other, more easily diagnosed diseases (eg, colibacillosis, pasteurellosis, herpesvirus infections, mycotic diseases) may mask chlamydial infection. Laboratory and clinical findings should be correlated. Chlamydiosis must be distinguished from other respiratory and systemic diseases of birds.

Treatment and Prevention

- Tetracyclines

Human and avian chlamydiosis is a **reportable disease**; state and local governmental regulations should be followed wherever applicable. No effective vaccine for use in birds is available. Treatment prevents mortality and shedding but cannot be relied on to eliminate latent infection; shedding may recur.
Tetracyclines (chlortetracycline, oxytetracycline, doxycycline) are the antibiotics of choice. Drug resistance to tetracyclines is rare, but reduced sensitivity requiring higher dosages is becoming more common. Tetracyclines are bacteriostatic and effective only against actively multiplying organisms, making extended treatment times (from 2–8 weeks, during which minimum-inhibitory concentrations in blood must be consistently maintained) necessary. When tetracyclines are administered orally, additional sources of dietary calcium (eg, mineral block, supplement, cuttle bone) should be reduced to minimize interference with drug absorption.
Outbreaks of clinical disease in poultry flocks are not common. Treating infected flocks with chlortetracycline at 400–750 g/ton of feed for a minimum of 2 weeks has effectively decreased potential risk of infection for plant employees. The medicated feed must be replaced by nonmedicated feed for 2 days or more before slaughter and processing. Calcium supplementation must be withheld during treatment with chlortetracycline, with calcium concentration in the feed reduced to ≤0.7%. Medicated feed should be provided for 45 days if elimination of the organism is attempted. Persistence of oxytetracycline residues in eggs of laying hens is 9 days, and persistence of doxycycline residues is 26 days after administration at 0.5 g/L for 7 days. Use of some tetracycline antibiotics and doxycycline in poultry is prohibited, and state regulations must be followed.
In pigeons and companion birds, use of chlortetracycline-medicated feeds for 45 days was historically a standard recommendation for imported birds (see Chlamydiosis). Difficulties in palatability of the feed itself or the high level of antibiotic necessary for adequate blood levels have limited its use. Doxycycline is the current drug of choice, because it is better absorbed, has less affinity for calcium, better tissue distribution, and a longer half-life than other tetracyclines. Doxycycline added to feed or water can also result in adequate blood levels and has less effect on normal intestinal flora than does chlortetracycline.

The dosage and duration of the treatment varies between species. Protocols derived from controlled studies performed in the particular species treated should be used when available (see Chlamydiosis). Also see information in the Compendium of Measures To Control Chlamydophila psittaci Infection Among Humans (Psittacosis) and Pet Birds (Avian Chlamydiosis), 2017, National Association of State Public Health Veterinarians. When specific information is lacking, an empiric starting dosage of 400 mg/L of water, or 25–50 mg/kg/day, PO, for 45 days has been suggested. Treatment of poultry with doxycycline is extra-label and use should follow state regulations.

Appropriate biosecurity practices are necessary to control the introduction and spread of chlamydiae in an avian population. **Minimal biosecurity standards include:**

- quarantine and examination of all new birds
- prevention of exposure to wild birds
- traffic control to minimize cross-contamination
- isolation and treatment of affected and contact birds
- thorough cleaning and disinfection of premises and equipment (preferably with small units managed on an all-in/all-out basis)
- provision of uncontaminated feed
- maintenance of records on all bird movements
- continual monitoring for presence of chlamydial infection

The organism is susceptible to heat (it may be destroyed in <5 minutes at 56°C) and most disinfectants (eg, 1:1,000 quaternary ammonium chloride, 1:100 bleach solution, 70% alcohol, etc) but is resistant to acid and alkali. It may persist for months in organic matter such as litter and nest material; thorough cleaning before disinfection is necessary.

Zoonotic Risk

Avian chlamydiosis is a **zoonotic disease** that can affect people after exposure to aerosolized organisms shed from the digestive or respiratory tracts of infected live or dead birds or handling of infected birds, tissues (eg, slaughterhouse), or bedding. **Human disease most often results from exposure to pet psittacines** and can occur even if there is only brief contact with a single infected bird. Other persons in close contact with birds, such as pigeon fanciers, veterinarians, farmers, wildlife rehabilitators, zookeepers, and employees in slaughtering and processing plants or hatcheries, are also at risk. Zoonotic transmission of *C psittaci* in poultry industry workers is likely underestimated.

Precautions should be taken when examining live or dead infected birds to avoid exposure (eg, dust mask and plastic face shield or goggles, gloves, detergent disinfectant to wet feathers, and fan-exhausted examining hood). Infection in people varies from asymptomatic to flu-like symptoms and respiratory disease (eg, pneumonia). Rarely, endocarditis, myocarditis, hepatitis, and encephalitis occur. Immunocompromised people are at increased risk of developing clinical disease.

Key Points

- **Avian chlamydiosis is a systemic bacterial infection caused by *Chlamydia psittaci*.**
- **Diagnosis in poultry is by serology, necropsy, and PCR.**
- **Chlortetracycline and doxycycline are used to treat chlamydiosis.**
- **Chlamydiosis is a reportable disease, with human cases most often caused by exposure to pet psittacines.**