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Case Report—

Chlamydiosis in Pen-raised Bobwhite Quail (Colinus virginianus) and Chukar Partridge (Alectoris chukar) with High Mortality

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SUMMARY. In a flock of 12,000 bobwhite quail (Colinus virginianus) and 7200 chukar partridge (Alectoris chukar), the owner had 100% morbidity and 40%–50% mortality in birds between the ages of 2 and 4 wk. Affected birds were stunted and anorexic and had yellow/green diarrhea. Two- and 4-wk-old birds submitted for necropsy all had slight nasal discharge. Histopathologic examination revealed mild (bobwhite) to severe (chukar) rhinitis. Immunohistochemistry was positive for Chlamydia psittaci in all birds. Chlamydia psittaci organisms were demonstrated histopathologically in hematoxylin and eosin and Gimenez-stained slides. Management sanitation and treatment with chlortetracycline stopped further excessive losses. The owners were also infected. Treatment by their local physician with tetracycline alleviated symptoms.

RESUMEN. Reporte de Caso—Clamidiosis con alta mortalidad en codornices (Colinus virginianus) y en perdíces indias (Alectoris chukar) criadas en corrales de piso.

En una parvada de 12000 codornices blancas (Colinus virginianus) y 7200 perdíces indias (Alectoris chukar), se observó una morbibilidad del 100% y una mortalidad del 40%–50% en aves entre dos y cuatro semanas de edad. Las aves afectadas mostraban enanismo, inapetencia y tenían diarrea de color amarillo verdosa. Las aves de dos a cuatro semanas enviadas para necropsia presentaban ligera descarga nasal. El examen histopatológico reveló una rinitis suave en las codornices y severa en las perdíces indias. El examen inmunohistoquímico fue positivo para Chlamydia psittaci en todas las aves. La Chlamydia psittaci fue observada histopatológicamente por medio de la tinción de Gimenez y de la hematoxilina eosina. Medidas de manejo sanitario y el tratamiento con clortetraciclina evitaron mayores pérdidas. Los propietarios también se infectaron y el tratamiento con tetraciclina alivió los síntomas.

Key words: Chlamydia psittaci, chlamydiosis in bobwhite quail, zoonotic chlamydiosis

Chlamydia psittaci is a bacteria that causes disease in birds and humans (1). The organism was originally isolated from psittacine birds and the disease was called psittacosis or parrot fever (8). Later, C. psittaci was shown to infect turkeys and other fowl, and the disease was called ornithosis (5,6). The organism isolated from the different species of birds is currently considered the same, and the preferred term for the disease in both birds and humans is chlamydiosis (9).

The disease is more severe in young birds (10). Clinical signs can include lethargy, nasal and eye discharges, depression, anorexia, respiratory distress, and yellow diarrhea (7,10). Psittacines, gulls, egrets, and turkeys generally harbor the more virulent strains (10). Older birds are often nonsymptomatic carriers and shredders (1). Avian strains of C. psittaci can also infect humans (1). Pathogenic strains of C. psittaci causing clinical signs and mortality have not previously been reported in quail (Schwartz, pers. comm.).

This case report documents chlamydiosis in a flock of bobwhite quail (Colinus virginianus) and chukar partridge (Alectoris chukar) experi-
The owners and their adult children who worked with the birds were subsequently diagnosed with *Chlamydia psittaci* infection.

**CASE REPORT**

**History.** Four 2-wk-old and four 4-wk-old bobwhite quail (virginianus) and six 4-wk-old chukar partridge were submitted to Murray State University Breathitt Veterinary Center in June 1998. The birds were from a game bird farm housing 12,000 bobwhite quail and 7200 chukar partridge that suddenly experienced 100% morbidity and 40%–50% mortality in birds between the ages of 2 and 4 wk. The farm incubated and hatched both species of birds. The quail were hatched from eggs purchased from an egg supplier certified clean for *Salmonella* and *Mycoplasma*. The chukar partridge were hatched from eggs of 300 breeder birds maintained in separate facilities on the farm. Every 2 wk, 1500 quail eggs and 900 partridge eggs were set and incubated. Eggs were incubated together, and the species were separated for hatching.

Both partridge and quail chicks were brooded and started together in a 32-ft by 75-ft house with six partitions. Chicks were brooded at one end of the house where the fresh air inlets were located. At 2-wk intervals, chicks were moved to the next partition farther from the fresh air supply. At 6 wk, both species were moved to large ground flight pens. Chicks were fed crushed quail starter pellets, 28% protein, that contained virginiamycin (PFizer, Lee's Summit, MO), 20 g/ton.

The first two hatches showed no clinical signs of infection. During the next two hatches, birds displayed no signs nor symptoms of disease until about 2 wk of age. Anorexia, yellow/green diarrhea, respiratory discharge, and stunting would occur between 2 and 6 wk. Virtually 100% of the birds in the brood/start house older than 2 wk of age displayed clinical signs. Mortality was between 40% and 50%. Birds showing diarrhea were more severely affected. Four or 5 days after transfer to flight pens, clinical signs and mortality abated. There were no sequella; those birds that survived would continue to normal adulthood.

**Zoonosis.** The owners, husband and wife, and one adult son who regularly worked with the birds reported having stuffy head, cough, sneezing, mild sore throat, tightness of the chest, and headaches of several weeks' duration. A second adult son who worked sporadically with the birds had similar symptoms; however, his 7-yr-old daughter, who often interacted with the birds, and his pregnant wife, who had infrequent contact with the birds, did not display any symptoms. An adult daughter who never went near the birds, but recalled previous contact with a normal-appearing parrot, had the most severe respiratory signs. When the owners learned that the birds had chlamydiosis, they contacted their local physician and requested that the family be tested for the disease. Serologic results for chlamydia antibodies, immunoglobulin G (positive, ≥1.10) (LabCorp, Louisville, KY), indicated the husband (1.92), his wife (1.33), both adult sons (2.06, 2.13), and adult daughter (3.00) tested positive. Titers from the pregnant daughter-in-law and her 7-yr-old daughter were negative (<0.91).

**Necropsy.** Antemortem findings in the 2-wk-old quail included stunting with ruffled feathers, serous to serosanguineous nasal discharge, and conjunctivitis with swollen eyelids (Fig. 1). The 4-wk-old quail had ruffled feathers with spotty feather loss over the dorsal head and body. One chick had slight serosanguineous, crusty discharge at the nostrils. One chukar was stunted and two had nasal discharge, one of which also had swollen eyelids.

Postmortem findings in the 2-wk-old quail included red, hyperemic conjunctival mucous membranes; congested, hyperemic sinuses; and white urate and fibrinous streaked abdominal air sacs. The 4-wk-old quail had congested and hyperemic nasal turbinates, clear serous to cloudy fibrinous abdominal air sacs, and small streaking hemorrhages in the femoral muscles. Only two of the 6-wk-old chukar displayed visible lesions. Congested and hyperemic conjunctival membranes and nasal turbinates were observed. Moderate numbers of *Eimeria* sp. oocysts were present in pooled fecal samples from each group of birds. Cryptosporidial organisms were not observed.

**Toxicology.** Analysis of the crushed starter feed and pellets fed to the older birds indicated that mycotoxins were within safe limits. By thin layer chromatography, aflatoxin B1, ochratoxin A, zearalenone, T-2, and Diacetoxyscirpenol...
were less than 10 ppb and vomitoxin was less than 1 ppb.

**Microbiology.** A genus-specific nested polymerase chain reaction procedure yielded negative results for the presence of *Mycoplasma* genus in lung, trachea, and choanal swabs. Lung mycotic cultures were negative for *Aspergillus* sp. *Pseudomonas aeruginosa* was isolated from lung and nasal swabs of each group and from liver from the chukar group. Other pathogenic bacteria were not isolated from nasal swabs, trachea, lung, or air sacs.

Transmission electron microscopy of nasal sinus, trachea, and lung was negative for virus particles. Testing methanol-fixed lung impression smears for the presence of *Chlamydia* was carried out by the fluorescent antibody technique. Fluorescein isothiocyanate-conjugated monoclonal antibody (Meridian Diagnostics, Inc., Cincinnati, OH) specific for all known serotypes of *C. psittaci*, as well as *Chlamydia trachomatis*, was used in the procedure. Results were weakly positive and reported as equivocal.

**Histopathology.** Selected tissues, fixed in 10% neutral buffered formalin overnight and processed by conventional methods, were embedded in paraffin, sectioned at 4 μm, mounted on precleaned glass slides, and stained with hematoxylin and eosin.

All three groups of birds had histopathologic lesions of the nasal turbinates. One of the 2-wk-old bobwhite quail had slightly hyperplastic turbinate epithelium. In the epithelial tissue were multifocal, mild to heavy accumulations of mononuclear leukocytes. Occasional heterophils were within these areas. In the 4-wk-old bobwhite, in two of four nasal turbinates, small accumulations of mononuclear leukocytes appeared in the submucosal lamina. In the 6-wk-old chukar partridge, the turbinate tissues were edematous. The epithelial surfaces and submucosal tissues were infiltrated with a fibrinous exudate containing mixed inflammatory cells. Small multifocal areas of necrosis with mixed inflammatory cell exudate were present in both epithelial and submucosal areas.

Lung tissues were unremarkable in the 2-wk-old quail, whereas one of four lung sections in the 4-wk-old quail had occasional areas of mononuclear leukocyte infiltration into the capillary air spaces. The lungs of the chukar partridge were unremarkable. Air sac sections from the chukar displayed greatly hyperplastic tissue infiltrated with a fibrinofibrous material.

Fig. 1. Two-week-old bobwhite quail with crusty serosanguineous nasal discharge and swollen eyelids.
Chlamydiae psittaci were skeletal elementary bodies. Sections were counterstained lightly with hematoxylin (Ventana Medical Systems, Inc.). Lung macrophages from each group of birds were positive for C. psittaci.

**Treatment and results.** When losses first occurred, birds were treated for 2 wk with tylosin (Boehringer, St. Joseph, MO), 20 g/ton of feed. Mortality remained at about 50%. After laboratory diagnosis, the birds were treated with chlortetracycline (Durvet, Inc., Blue Springs, MO), 300 g/ton of feed, for chlamydiosis and monensin (Bovatec, Hoffman-La-Roche, Inc., Nutley, NJ), 80 g/ton of feed, for coccidiosis. Thorough cleansing and disinfection of the brooder/grow-out partitions and water/feed lines with 30% sodium hypochlorite (Vertex Chemical Corp., Dupo, IL) were conducted. Losses from later hatches dropped to less than 10%.

The humans were treated with tetracycline hydrochloride (Mylan Pharmaceuticals, Inc., Morgantown, WV), 250 mg daily for 15 days. The husband and the adult children had dramatic reduction of symptoms within 5 days. The wife reported only mild reduction of respiratory problems. Two weeks after completion of treatment, the husband reported return of respiratory symptoms. Tetracycline treatment was resumed and symptoms cleared within 3 days. The wife's respiratory symptoms remained at a reduced level.

**DISCUSSION**

At initial submission, the clinical history of these birds included watery eyes, conjunctivitis, nasal discharge, and sinusitis, along with histopathologic observations of moderate to severe rhinitis with mild lung lesions that were highly suggestive of *Mycoplasma* infection (1,4). However, negative polymerase chain reaction DNA probe tests for *Mycoplasma* genus ruled out their possible role in these infections. Thereafter, immunohistochemistry revealed positive reactions for *C. psittaci* in the lungs, and special stains for *Chlamydia* were ordered. When histopathologic examination demonstrated *Chlamydia* organisms, the owners were informed of the diagnosis. Treatment of the birds was im-

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**Fig. 2.** Lung, capillary air space macrophage with multiple *Chlamydiae psittaci* elementary bodies. ×400.
mediately initiated. Recovery of the original tissue revealed it to be unsuitable for isolation attempts.

Once treatment was started, subsequent attempts to isolate and demonstrate *Chlamydia* organisms were negative, even in birds continuing to display typical signs.

 Owner discussion with personnel from the quail breeder flocks revealed no unusual disease problems that would indicate chlamydiosis. Subsequent testing of hens from the chukar breeders failed to reveal evidence of *C. psittaci*. Although the eggs could have harbored *C. psittaci* organisms from external fecal contamination, we believe this was unlikely until after the first group of chicks was severely affected.

Although chlamydiosis can be a serious disease in chukar partridge (12), it has not been reported as causing excessive mortality in bobwhite quail (Schwartz, pers. comm.). The close proximity of each species during the early growing period suggests that both quail and partridge were infected with a pathogenic strain of *C. psittaci* that contributed to excess mortality.

The clinical signs of chlamydiosis vary greatly in severity and depend on the age of the bird and strain of the organism (1). Many avian species harbor *Chlamydia* organisms without showing clinical signs (1). These birds act as carriers and can spread the disease. During periods of stress, carrier birds can break out with chlamydiosis (11,13). Chlamydiosis is usually systemic; thus, infected birds may be further stressed by *Chlamydia* infection, and these stressed birds would be susceptible to secondary bacterial infections, including infection with *Pseudomonas* organisms. Coinfection of *C. psittaci* and *P. aeruginosa* likely contributed to the high mortality of the quail and partridge chicks. Coccidial infection could have contributed to chick stress. The mild to moderate histopathologic lesions suggested that this variable may also have been a coinfection factor.

In chickens and turkeys, *Pseudomonas* produces respiratory infections (2). Because *P. aeruginosa* is an opportunist in weakened tissues (3), its isolation from the lungs of the birds was not surprising. *Pseudomonas aeruginosa* was later isolated from water lines in the starter facility. Vigorous cleaning and disinfection of water lines and cleaning and sanitation of the brooder and starter building were undertaken and probably accounted for less secondary bacterial infection. *Chlamydia* are very susceptible to chemicals that affect their lipid content or the integrity of their cell walls (1). Even when *Chlamydia* are in tissue debris, their infectivity is destroyed within minutes by all common disinfectants except cresol and lime (1). Multiplication of all strains of *Chlamydia* is strongly inhibited by appropriate concentrations of tetracyclines (1). Treatment of *Chlamydia* with chlorotetracycline together with management sanitation to inhibit *Pseudomonas* likely contributed to success in reducing mortality. Coccidiosis treatment with monensin reduced stress.

The origin of the *C. psittaci* infection was never established. On the affected farm, a human-to-bird zoonotic infection was suspected. The adult daughter, who worked in an establishment where a client regularly brought a pet parrot, was the first to display upper respiratory symptoms. Others in the family then contracted "flu-like" symptoms. The epornitic in the birds was believed to occur after the humans became ill. Unfortunately, circumstances did not allow testing of the parrot. Parrot-to-human-to-chukar transmission is speculative but remains the suspected primary route of transmission.

Reservoirs of *Chlamydia* have been reported to include pigeons, blackbirds, grackles, house sparrows, and killdeer (1). All of these avian species could be found in the vicinity of the affected farm. Possibly a wild avian species transmitted the organism to chukar and bobwhite on the farm. If the *C. psittaci* infection came from birds, the chukar partridge were likely infected first (13). Vertical transmission has been suggested to occur from infected eggs (5,6,14). Two of six chukar submitted for examination displayed mild nasal and conjunctival signs. Commingling of the partridge and quail likely resulted in the infection of the bobwhite chicks.

This case report was interesting in that it was the first reported incident of *C. psittaci* epornitic with increased mortality in bobwhite quail. The report also was a reminder of the zoonotic potential of chlamydiosis in game birds and their handlers.

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