Exotic Newcastle Disease Backgrounder

(January 26, 2006)

Causative agent

Newcastle disease virus (NDV), also called avian paramyxovirus type 1, is a member of the paramyxoviridae family of viruses. These viruses are 150 to 300 nanometer (nm), enveloped, pleomorphic (have two or more shapes or forms), single-stranded, negative-sense RNA viruses. The paramyxoviridae family is subdivided into two subfamilies: paramyxovirinae and pneumovirinae. There are seven to eight closely related antigenic varieties of NDV. Other members of the paramyxovirinae subfamily include the causative agents of canine distemper, rinderpest, and canine parainfluenza type 2. Most viruses in this family are susceptible to heat, drying, lipid solvents, and most disinfectants.

Pathotypes of NDV have been recognized based on the virulence and pathogenicity of NDV infection in chickens. The pathotypes are, in order of decreasing virulence, velogenic, mesogenic, and lentogenic. Pathotypes are further subdivided into clinical syndromes: viscerotropic velogenic NDV, neurotropic velogenic NDV, mesogenic NDV, lentogenic NDV, and asymptomatic enteric NDV. Velogenic Newcastle disease is the most virulent form of the disease; the viscerotropic and neurotropic velogenic pathotypes of NDV are considered together as exotic Newcastle disease (END). Newcastle disease is attributed to the mesogenic and lentogenic pathotypes. Asymptomatic enteric NDV produces infection without clinical signs of disease. These pathotypes are not clearly separate, and overlapping of pathotypes can occur.

Natural distribution

Although the first outbreaks recognized as Newcastle disease occurred in Indonesia in 1926, it has been suggested that a large outbreak in Scotland in 1896 was due to NDV. The disease was named for a large outbreak that occurred in Newcastle, England in 1927.

More than 250 avian species are susceptible to natural or experimental infection with NDV. Chickens are the most susceptible species, and ducks and geese are the least susceptible to NDV/END. A carrier state may exist in psittacine birds (parrots, lories, cockatoos, and parakeets) and some other wild birds. Wild birds may serve as reservoirs of disease in some tropical areas. Some psittacine birds are able to shed the ND virus intermittently for more than one year; Amazon parrots are capable of shedding NDV for more than 400 days. Chickens usually shed the virus for 14 days or less.

Newcastle disease virus is endemic in many countries of the world. The velogenic pathotypes (END) are endemic in many countries of the Middle East, Africa, Asia, Central America, and South America. Exotic Newcastle disease is not endemic in the United States, and is therefore considered a reportable disease. A serious outbreak of END occurred in southern California in 1971, resulting in the slaughter of 12 million birds and containment costs of approximately $56 million. Another serious outbreak occurred in southern California in 2002 to 2003, resulting in depopulation of more than 3 million birds and containment costs exceeding $160 million.

Newcastle disease, especially END, is an economically devastating disease of poultry and bird species. The World Organization for Animal Health (OIE) classifies Newcastle disease as a listed disease because of the potential for rapid spread and substantial impact on international trade of animals and animal products. Newcastle disease (including END) was recognized in the Agricultural Bioterrorism Act of 2002 as an agent that could pose a severe threat to animal health, human health, or animal products in the United States.

Transmission

Introduction of NDV into a flock most likely results from the introduction of an inapparently infected bird. Exotic pet birds, exposition birds, waterfowl, and domestic poultry can serve as carriers of NDV. Smuggled birds present a significant risk of introduction of NDV.

Transmission occurs via direct contact with infective feces, droplets, respiratory discharges, fomites (contaminated feed, water, tools, housing, equipment, vehicles, boots, human hands), tissues, carcasses, or virus-infected eggs. Mice, reptiles, and flies can also serve as fomites for transmission of disease. Windborne viral transmission was implicated in outbreaks in the United Kingdom in 1970 to 1972, but its role in the propagation of disease outbreaks is dependent on environmental and climactic conditions. Newcastle disease virus can persist in water for up to 21 days, and in carcasses for up to seven days during hot weather. The virus can survive indefinitely in frozen material.

The incubation period for NDV following natural exposure is approximately two to 15 days. Aerosol transmission may result in a reduced incubation period when compared to fecal-oral transmission. The incubation period in chickens is two to six days, a reflection of the species' susceptibility to NDV. Some bird species may incubate the virus for longer periods of time. Newcastle disease virus is shed during the incubation period and also during a portion of the convalescent period.

Nonlaboratory-origin human infection with NDV most likely develops as a result of rubbing eyes with hands that have handled infective tissues or fluids.

Clinical Signs

Sudden death without prior indication of illness is a common sign of END in unvaccinated chicken flocks. Ten to 15% of the flock may die within 24 to 48 hours.

Severe depression and neurologic signs are the most commonly observed signs of END due to infection with the neurotropic velogenic forms of NDV. Respiratory signs that may be observed include gasping and coughing. Neurologic signs include drooping wings, muscular tremors, abnormal head and neck position, leg dragging, circling, depression, loss of appetite, and paralysis. Egg production may be reduced, or may cease; eggs may be misshapen, with rough, thin shells and watery albumen. Birds surviving 12 to 14 days may display permanent paralysis or other permanent neurologic deficits. The reproductive system may be impaired, resulting in cessation or permanent reduction of egg production. Vaccinated birds may exhibit less severe clinical signs, but severe clinical signs and death may still occur.

The viscerotropic velogenic pathotype of NDV produces edema of the tissues of the head and neck. Because of poor blood circulation, a dark ring (black eye) may develop around the eyes. Green, watery diarrhea may be observed. Hemorrhagic lesions are detected in the intestinal tract. The viscerotropic form of END in psittacine birds may produce clinical signs similar to those produced by the neurotropic form in chickens.

Turkeys with END exhibit respiratory and neurologic signs, and infection in ducks and geese is usually asymptomatic. Pigeons typically exhibit diarrhea and neurologic signs, whereas exotic birds and cormorants are more likely to exhibit only neurologic signs. Finches and canaries may become asymptomatically infected with END.

Although human infection with END can occur, the disease is generally limited to conjunctivitis (inflammation of the tissues around the eyes) that rapidly resolves. Respiratory symptoms have rarely been reported. Humans at highest risk include laboratory workers and vaccinating crews. No human cases have been reported of END resulting from handling or ingestion of poultry products.

Infection with the mesogenic pathotype of NDV may result in sudden onset of dullness, coughing, and sneezing. A dramatic reduction in egg production may be observed. Adults are less severely affected, but chicks exhibit higher case fatality rates (the number of cases that die from the disease). Affected chicks may develop neurologic signs, including wing droop, abnormal head and neck position, and paralysis, after respiratory signs subside.

The lentogenic pathotype of NDV causes mild, upper respiratory tract infections in adult birds. Younger, more susceptible birds may develop more severe respiratory signs. Reduced production is also associated with lentogenic NDV infection in domestic poultry.

Diagnosis

Exotic Newcastle disease produces clinical signs similar to those observed with avian influenza, fowl cholera, and other infectious diseases; therefore, a final diagnosis of END must be made based on virus isolation and identification. Virus isolation and virulence testing involves the inoculation of embryonating chicken eggs and testing the chorioallantoic fluid for hemagglutination activity; if positive, the hemagglutination-inhibition test is performed to confirm the presence of NDV.

A full diagnosis of Newcastle disease requires the assessment of virulence. Once the presence of NDV infection is confirmed, virulence can be assessed using the intracerebral pathogenicity index in one-day-old chicks, the mean death time in chicken embryos, the intravenous pathogenicity in six-week-old chicks, or nucleotide sequencing.

Serologic assays for NDV include the hemagglutination inhibition test and an enzyme-linked immunosorbent assay (ELISA). Tracheal swabs, cloacal swabs, organ swabs, or feces may be submitted for testing. Specimens should be kept on ice, or quick-frozen if they cannot be submitted to a laboratory within 24 hours. Prior vaccination will affect results of serologic testing.

Treatment

Exotic Newcastle Disease is a reportable disease. State or Federal animal health officials should be immediately notified when END is observed or suspected. There is no treatment for END.

Morbidity and Mortality

Morbidity and case fatality rates associated with END/Newcastle disease vary widely, and are influenced by the strain/pathotype of the virus, age and species of bird, vaccination status, environmental conditions, and the presence of concurrent infection. Chickens, peafowl, guineas, pheasant, quail, and pigeons are most severely affected by END. Infection with velogenic strains, associated with END, can incur morbidity rates approaching 100% and case fatality rates (the number of clinical cases that die from the disease) as high as 90 to100% in susceptible chickens.

The case fatality rate of chicks infected with the mesogenic pathotype of NDV can reach 50%. Lentogenic pathotypes are associated with lower mortality.

Prevention and Control

The most challenging aspect of prevention and control of END and Newcastle disease is the identification of carriers. Routine submission of samples from dead birds is one method of detection. Placement of sentinel birds (unvaccinated and pathogen-free) also facilitates detection; if END is present, sentinel birds will die from END within a week of introduction into the flock. Use of sentinel birds to detect END is more problematic in caged layer flocks because of decreased physical exposure to resident birds.

Thirty-day isolation of newly acquired birds is recommended for prevention of NDV infection. Restricted movement of personnel and equipment between new birds and resident birds is also important. All birds legally imported into the United States are subject to quarantine and testing before they enter the country.

During outbreaks, strict quarantine is mandatory. Personnel must observe proper hygiene procedures and wear appropriate personal protective equipment. All infected and exposed birds and their eggs are destroyed. The premises and equipment are thoroughly cleaned to remove all organic material and then disinfected, followed by the application of a residual disinfectant (such as phenolic or cresylic disinfectants). If earthen floors are present in the houses, at least one inch of topsoil must be removed with the manure. Manure should be buried a minimum of five feet below ground or composted in an insect-, bird-, and vermin-resistant manner for a minimum of 90 days (longer during cold weather). The facility is not restocked for a minimum of 21 days following disinfection.

NDV is susceptible to irradiation, oxidation, 3% sodium hypochlorite solutions, phenol disinfectants, acids, and alkalis. It is destroyed by direct sunlight within 30 minutes.

Vaccination of susceptible flocks is performed in most countries. Live and inactivated (killed) viral vaccines are available. Newcastle disease virus vaccines utilize the mesogenic (M) or lentogenic (L)

strains of NDV. Live viral vaccines, such as the Hitchner-B1 (L), La Sota (L), V4 (L), NDW (L), I2 (L), Roakin (M), Mukteswar (M), and Komarov (M) strains are administered in drinking water, as a coarse spray, with intranasal or intraocular inoculation, or wing-web intradermal injection. Killed virus vaccines are recommended for flocks with concurrent disease, such as Mycoplasmosis; these vaccines are associated with higher expense, and administration requires the handling of individual birds. Use of vaccines can make detection and/or eradication of NDV more difficult; the antibodies produced in reaction to the vaccine can interfere with serologic testing, and vaccination may reduce disease detection by increasing resistance to infection and reducing, but not eliminating, viral shedding.