

VELOGENIC NEWCASTLE DISEASE

(Exotic Newcastle disease, Asiatic Newcastle disease)

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Definition [top](#)

Velogenic Newcastle disease (VND) is the most severe form of Newcastle disease and is likely the most serious disease of poultry throughout the world (2,4,13). In chickens it is characterized by lesions in the brain or gastrointestinal tract, morbidity rates near 100 percent, and mortality rates as high as 90 percent in susceptible chickens. Neurologic signs or severe depression are the most obvious clinical sign, and some nonvaccinated birds may be found dead with no detected sign of prior illness.

Etiology [top](#)

Newcastle disease viruses (NDV's) occur as three pathotypes: lentogenic, mesogenic, and velogenic, reflecting increasing levels of virulence. The most virulent (velogenic) isolates are further subdivided into neurotropic and

viscerotropic types. The velogenic isolates are considered exotic to the United States, and the disease caused by these VND isolates is the subject of this chapter.

The Newcastle disease viruses belong to the *Paramyxoviridae* virus family and, like other members of this group, possess two surface proteins that are important to the identification and behavior of the virus. The first, hemagglutinin/neuraminidase (HN) is important in the attachment and release of the virus from the host cells in addition to its serologic identification. The other very important surface protein is the fusion (F) protein, which has a critical role in the pathogenesis of the disease. There are at least nine known types of avian paramyxoviruses based on the antigenic makeup of the hemagglutinin. NDV is the prototype virus for Type 1 avian paramyxoviruses.

Host Range [top](#)

Inapparently infected carriers that are the most likely source for introduction of VND include numerous species of exotic pet and exposition birds, waterfowl, and domestic poultry (18). A persistent carrier state has been demonstrated in psittacine (8) and in certain other wild birds (19) whereas virus can be recovered from chickens for shorter periods of time, usually 14 days or less.

Geographic Distribution [top](#)

Velogenic Newcastle disease is endemic in many countries of Asia, the Middle East, Africa, and Central and South America. Some European countries are considered free of VND. VND has caused high mortality in wild cormorants in Canada and the United States.

Transmission [top](#)

In many parts of the tropics VND is recurrent in the poultry populations. One possibility is that they are infected from a wild bird reservoir. Additional studies will be required before it can be established which species, if any, are true carriers and which are only transiently infected. It is not known whether the occurrence of VND in wild birds moving in international trade can be reduced by avoiding the capture of certain species or their collection at certain time periods or places. Once introduced into poultry, the virus spreads farm-to-farm by the movement of inapparently infected poultry species; on contaminated objects such as boots, sacks, egg trays, and crates; or by flies (5) or mice. Reports from England (11) that the virus can be wind-borne under certain conditions should be considered even though there was no evidence of airborne transmission between premises

with the virus that caused the 1971 outbreak in California. Free-flying wild birds apparently had no role in the spread of VND during that outbreak (16).

Incubation Period [top](#)

The incubation period for Newcastle disease after natural exposure varies from 2 to 15 days. For VND in chickens, an incubation period of 2 to 6 days is common. The incubation period in other species of birds may be longer.

Clinical Signs [top](#)

Velogenic Newcastle disease is a devastating malady in unvaccinated chickens of any age. The first sign in laying chickens is usually a marked drop in egg production followed within 24 to 43 hours by high death losses. At the onset, 10-15 percent of a flock may be lost in 24 hours. After 7 to 10 days, deaths usually subside, and birds surviving 12 to 14 days generally do not die but may display permanent paralysis and other neurologic signs. The reproductive system may be permanently impaired, and thus egg production does not return to previous levels. In vaccinated chickens, or chicks protected by parental antibodies, the clinical signs are less severe and are proportional to the level of protective antibodies.

With viscerotropic strains (VVND), edema of the head, especially around the eyes (Fig. 107) may become apparent after birds have been sick for 2 or 3 days (9). This edema usually does not involve the comb and wattle to the extent of highly pathogenic avian influenza (HPAI). A dark ring sometimes forms around the eye, probably due to cyanosis and poor blood circulation in the edematous tissue. This "black eye" appearance is especially visible in white chickens.

Bile-stained, greenish-dark diarrhea may be noted 2 to 3 days after onset of illness. Some birds in an affected flock usually have diarrhea throughout the course of the disease.

The most noteworthy clinical sign in unvaccinated flocks is sudden death without prior indications of illness. The peracute onset often causes the owner to suspect poisoning.

Respiratory distress and signs of neurological disturbances, such as drooping wings, torticollis, and ataxia, may not be as marked as they are with the neurotropic forms of the disease. However, these neurologic signs are frequently observed in chickens that survive infection with the viscerotropic strains for 2 or 3 weeks. Because of lack of experience with viscerotropic strains, poultry owners throughout the United States and Canada may not consider Newcastle disease as

a possible diagnosis unless they see the neurologic signs they have seen with the domestic neurotropic viruses.

Neurotropic strains cause respiratory signs soon followed by neurologic signs, including muscular tremors, paralysis of legs or wings, torticollis, and opisthotonos. There is a marked decline in egg production but usually no diarrhea. Disease signs may differ markedly, depending on the host species. Psittacines or pigeons infected with the viscerotropic strains of virus may display neurologic signs typical of the disease caused by the strains of neurotropic ND in chickens (7). These same viscerotropic viruses may cause typical signs and lesions of VVND when inoculated into chickens (6). In some species, such as finches and canaries, clinical disease may not be observed.

Gross Lesions [top](#)

No gross lesion may be observed in many of the first birds dying in a commercial poultry operation. Peracute deaths are generally due to collapse or dysfunction of the reticuloendothelial system before discernible gross lesions have developed. There is no pathognomonic gross lesion for VVND, but, generally, sufficient lesions can be found to make a tentative diagnosis if enough birds are examined (14). Because of the marked similarities between the gross lesions of VVND and highly pathogenic avian influenza, a final diagnosis in the first flocks must await virus isolation and identification. In a continuing outbreak where numerous flocks are involved, gross observations may eventually be all that is necessary when typical lesions are present.

Edema of the interstitial tissue of the neck, especially near the thoracic inlet, may be marked. After the trachea and esophagus are exposed during necropsy examination, straw colored fluid may drip from these tissues. Congestion and occasionally hemorrhage may be seen in the trachea generally corresponding to the rings of cartilage.

Proventriculus

Petechial and small ecchymotic hemorrhages may be present on the mucosa of the proventriculus (Fig. 108). These small hemorrhagic foci tend to be found near the base of the papillae and concentrated around the posterior and anterior orifices.

Intestine

Peyer's patches (Fig. 109), cecal tonsils (Fig.110), and other focal aggregations of

lymphoid tissue in the gut wall usually are markedly involved and are responsible for the term viscerotropic applied to this form of Newcastle disease. These areas progressively become edematous, hemorrhagic, necrotic, and ulcerative. In chickens that have died from VVND, these involved lymphoid areas can often be observed without opening the gut.

Reproductive System

Ovaries may be edematous, hemorrhagic, or degenerated. Yolk peritonitis can frequently be observed in layers as a result of VVND, and rough, misshapen eggs are frequently laid by recovering hens.

Neurotropic strains of VND may cause few gross lesions other than in the trachea and lungs. There will be no gross lesion in the brain of diseased birds. Gross lesion patterns usually differ markedly between the disease caused by the viscerotropic and neurotropic velogenic viruses.

Morbidity and Mortality [top](#)

Clinical VND is most severe in chickens, peafowl, guineas, pheasant, quail and pigeons. Turkeys may develop a milder form of the disease. Severity of disease in psittacine and passerine birds is variable. In susceptible chickens, the morbidity and mortality rates can be as high as 100 percent and 90 percent, respectively. In some species such as finches and canaries, clinical disease may not be observed.

Diagnosis [top](#)

Field Diagnosis [top](#)

A tentative diagnosis of VND may be made on the basis of history, clinical signs, and gross lesions, but because of similarities to other diseases such as fowl cholera and highly pathogenic avian influenza, confirmation requires virus isolation and identification.

Specimens for the Laboratory [top](#)

Virus can readily be recovered from sick or recently dead birds. Swabs are the most convenient way to transfer VND virus from tissues or secretions of the suspect bird to brain and heart infusion broth or other cell culture maintenance medium containing high levels of antibiotics (1). Trachea, lung, spleen, cloaca, and brain should be sampled. Swabs should be inserted deeply to ensure obtaining

ample epithelial tissue. If large numbers of dead or live birds are to be sampled, cloacal swabs from up to five birds can be pooled in the same tube of broth. An alternate technique is to place 0.5 cm³ of each tissue into the broth. If the specimens can be delivered to a laboratory within 24 hours, they should be placed on ice. If delivery will take longer, quick-freeze the specimens and do not allow them to thaw during transit.

Laboratory Diagnosis [top](#)

In the laboratory, virus isolation is attempted by inoculating 9- to 11-day-old embryonating chicken eggs. Chorioallantoic fluid (CAF) is collected from all embryos dying after 24 hours postinoculation and tested for hemagglutination (HA) activity. If positive, the hemagglutination-inhibition (HI) test is used with known NDV-positive serum to confirm the presence of NDV in the CAF (3). If NDV is found, it is characterized by inoculating 4- to 6-week-old chickens free of ND antibodies with the suspect CAF by swabbing the cloaca, instilling into the nares or conjunctival sac, or injecting into the thoracic air sac. If VVND virus is present, the inoculated chicks usually die in 3 to 7 days, revealing typical visceral lesions on postmortem examination. Neurotropic VVD viruses will cause severe neurologic and respiratory signs in inoculated chickens but no visceral lesions. If no bird dies in 10 days, the NDV is not considered to be the velogenic, viscerotropic type but is either a lentogen or mesogen.

Differential Diagnosis [top](#)

The viscerotropic, velogenic Newcastle disease in poultry can be confused with highly pathogenic avian influenza, infectious laryngotracheitis, fowl cholera, and coryza.

Vaccination [top](#)

Vaccination with viable or inactivated oil emulsion vaccines, or both, can markedly reduce the losses from VND in poultry flocks. If eradication of the virus is not the goal of the control program, vaccines can be used to lessen the impact of the disease. Their use, however, can make the complete eradication of the virus much more problematic by increasing the difficulty of identifying infected flocks. There is little doubt, however, that vaccination makes the flock more refractive to infection when exposed and reduces the quantity of virus shed by infected flocks.

Control and Eradication [top](#)

Before 1972, VND was introduced into the United States on several occasions by

unrestricted introduction of exotic pet birds, especially psittacine birds. Because pet birds are not usually associated with domestic poultry, VND outbreaks were rare (20). Since 1973, restrictions on the importation of exotic birds requiring the quarantining and testing of imported birds in approved quarantine facilities have reduced but not eliminated the threat of VND in the United States. Illegally imported exotic bird species remain the source of frequent outbreaks of VND in private or commercial aviaries.

The establishment of a strict quarantine and destruction of all infected and exposed birds with financial indemnification for losses followed by thorough cleaning and disinfection of premises were the main features necessary for eradication of VND virus from the poultry producing area of southern California. Flocks may be safely and humanely destroyed using carbon dioxide in air-tight chambers and the carcasses disposed of by burying, composting, or rendering, depending upon the geographic area and the numbers involved. The VND virus has been recovered from effluent water for as long as 21 days and from carcasses for 7 days when the daytime temperatures were over 90o F. It is recommended that premises be kept free of domestic poultry for an additional 30 days after cleaning and disinfection are completed.

Insects and mice associated with the poultry should be destroyed before depopulation of a flock begins (5,12). Usually 48 hours is sufficient to control these vectors. As soon as all birds are killed and the manure and feed removed, all equipment and structural surfaces should be thoroughly cleaned using high-pressure spray equipment. The entire premises should then be sprayed with an approved residual disinfectant such as the cresylics or phenolics. Preliminary disinfection will probably inactivate most of the viruses on the surface of floors, equipment, cages, etc., but no disinfectant is effective unless it is applied to scrupulously cleaned surfaces free of all organic material.

Cleaning and disinfecting commercial poultry premises are time-consuming and expensive operations. All manure must be removed down to a bare concrete floor. If the floor is earthen, at least the top inch of soil should be removed with the manure. Manure can be safely disposed of by burying it at least 5 feet deep or by composting. If composting is used, the manure piles should be tightly covered with black polyethylene sheets in a manner to prevent access by birds, insects, and rodents during composting. These piles of manure should remain tightly covered and undisturbed at least 90 days during warm weather and for longer periods during cold weather. Recent studies indicate that proper composting can decompose carcasses and manure, and thus inactivate viruses in only a few weeks.

Feathers, usually numerous around commercial poultry premises, can be burned outside the buildings, and in some cases inside, with the careful use of a flame thrower, or they can be removed and the area wet down with disinfectant. The hot sun and high daytime temperatures will assist in destroying the virus in the area of the houses. Extremely cold temperatures will make the cleaning and decontamination process much more difficult, and the results more uncertain.

In 1997, because neither the neurotropic or viscerotropic strain of velogenic Newcastle disease was known to exist in the United States, USDA-APHIS declared both types to be exotic and therefore indistinguishable as to the response of disease control officials should they occur in the United States.

Surveillance [top](#)

The most difficult part of the VND eradication program is locating inapparently infected and exposed birds.

Repeated vaccination at 30 to 50 day intervals protects most chickens against clinical manifestation of VND. However, vaccine does not prevent all chickens in a flock from becoming infected, showing no disease sign, or shedding virulent virus. As individual chickens become susceptible and get exposed to the virus, they become infected and also shed the virus for a time. Thus, the virulent virus continues to be present in apparently healthy, vaccinated flocks. The advantages of using vaccines as part of a VND eradication program must be weighed against the difficulty created in finding asymptomatic but infected and virus-shedding flocks. In such instances owners should be encouraged to observe strict biosecurity measures to reduce the chances of their flocks being exposed to VND virus.

Infected carriers in vaccinated flocks can be detected using one of two systems. In the first, all birds dying during a 24-hour period are collected twice a week, and cloacal swabs and brains are collected and cultured for the presence of VND virus using the diagnostic sampling procedures described earlier. Birds in VND-infected flocks that die from Marek's disease, leukosis, gout, and numerous other disease conditions may yield VND virus—especially if their immune system was impaired by those diseases before death. In the second virus detection system, susceptible sentinel birds are placed in vaccinated flocks (18). The sentinel birds must be unvaccinated and obtained from a specific pathogen-free source to be certain that they do not inadvertently serve as a source of diseases for the suspect flock. In most instances the sentinel birds die from VND within a week or so after placement if there is VND virus present in the flock; however, in some cases it is sometimes difficult to place sentinel birds so they are adequately exposed to any

VND virus that may be in the flock — especially in caged-layer flocks.

Public Health [top](#)

Although people may become infected with VND virus, the resulting disease is typically limited to a conjunctivitis. Recovery is usually rapid, and the virus is no longer present in eye fluids after 4 to 7 days. Infections have occurred mostly in laboratory workers and vaccinating crews with rare cases in poultry handlers. No instance of transmission to humans through handling or consuming of poultry products is known. Individuals with conjunctivitis from VND virus should not enter poultry premises or come in contact with live avian species.

GUIDE TO THE LITERATURE [top](#)

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