

Newcastle Disease: From Clinical Signs to Modern Vaccination Strategies

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Newcastle disease (ND) is a highly contagious viral disease of poultry and is a notifiable disease under the World Organisation for Animal Health (WOAH) because of its rapid spread and potential to cause severe disease and mortality (Ara et al., 2009). Clinical severity ranges from subclinical infection to severe respiratory and neurological disease, with mortality approaching 100% in susceptible birds. Low-virulence NDV strains may circulate continuously and predispose birds to secondary respiratory infections, thereby reducing productivity and causing economic losses (Brown et al., 1999).

Newcastle disease virus (NDV) is a pleomorphic, enveloped virus with a non-segmented, negative-sense, single-stranded RNA genome that replicates in the cytoplasm (Miller et al., 2010). Its genome is approximately 15.2 kb and encodes six major structural proteins: nucleocapsid (N), phosphoprotein (P), matrix (M), fusion (F), haemagglutinin-neuraminidase (HN), and polymerase (L) (Shabbir et al., 2013).



Based on pathogenicity, NDV strains are classified as lentogenic, mesogenic, or velogenic, with increasing severity from mild respiratory infection to severe systemic disease (de Leeuw et al., 2005). Velogenic strains may be further described as viscerotropic or neurotropic according to their predominant pathological effects.

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Disease severity is influenced by viral virulence, host susceptibility and immunity, environmental stress, and concurrent infections. The fusion (F) protein cleavage site is a major determinant of NDV virulence. Polybasic cleavage sites facilitate activation by widely distributed host proteases and

support systemic viral replication. However, other viral proteins, including HN and replication-complex proteins, also contribute to pathogenicity. Viral virulence can be assessed using biological tests such as mean death time (MDT), intracerebral pathogenicity index (ICPI), and intravenous pathogenicity index (IVPI) (de Leeuw et al., 2005; Dortmans et al., 2011).

Transmission of Newcastle Disease Virus

Newcastle disease virus (NDV) is mainly transmitted through the respiratory and gastrointestinal routes following inhalation or ingestion of infectious virus. Birds may become infected by inhaling virus-containing droplets or aerosols, while ingestion of virus-contaminated faeces is an important route of bird-to-bird transmission.

Following natural exposure, the incubation period generally ranges from 2 to 15 days, with an average of approximately 5–6 days. The onset and severity of clinical disease depend on several factors, including the virulence of the infecting strain, susceptibility of the host, and prevailing environmental conditions (Kapczynski et al., 2013).

Clinical Signs

The clinical presentation of Newcastle disease varies according to the tissues and organ systems affected, particularly the respiratory, gastrointestinal, and nervous systems. Disease severity and progression are influenced by several factors, including bird species, age, immune status, virulence and dose of the infecting NDV strain, route of infection, environmental stress, and concurrent infections (Merino et al., 2011).

Low-virulence NDV infections commonly produce respiratory signs such as coughing, sneezing,

gasping, and abnormal respiratory sounds (Brown et al., 1999). In neurotropic velogenic infections, neurological manifestations such as tremors, wing and leg paralysis, torticollis, circling, muscle spasms, and complete paralysis may develop, often following the onset of respiratory signs (Wakamatsu et al., 2006; Susta et al., 2011).

Gross and Microscopic Lesions

Gross and microscopic lesions in Newcastle disease vary with the viral pathotype, host susceptibility, and concurrent infections, and lesions may occasionally be absent (Cornax et al., 2012).

Viscerotropic velogenic NDV commonly causes haemorrhagic and necrotic lesions in the proventriculus, intestine, and lymphoid tissues, along with respiratory congestion or haemorrhage (Cattoli et al., 2011). Histologically, severe infections are characterized by lymphoid depletion, necrosis, vascular damage, and respiratory epithelial injury, including oedema, inflammation, and loss of cilia (Brown et al., 1999; Mast et al., 2005).

Neurotropic strains may produce perivascular cuffing, neuronal degeneration, necrosis, and gliosis in the central nervous system (Wakamatsu et al., 2006). Mesogenic strains may cause enteritis and necrotic lesions in visceral organs, whereas lentogenic strains generally produce mild respiratory lesions (Piacenti et al., 2006).

Vaccination and Modern Vaccination Strategies

Vaccination is one of the most important components of Newcastle disease control. Live attenuated vaccines, including LaSota and B1 strains, are widely used because of their safety and immunogenicity. Other

vaccines, including VG/GA and thermostable genotype I strains such as V4 and I-2, may provide respiratory or mucosal protection and are particularly useful in areas where maintenance of the cold chain is challenging (Habibi et al., 2020).

Although conventional vaccines effectively reduce clinical disease and mortality, they may not completely prevent infection, viral replication, or viral shedding when vaccinated birds are exposed to genetically distinct field strains (Hu et al., 2022).

Although NDV is generally considered a single serotype, considerable genetic and antigenic diversity occurs among circulating genotypes, particularly between traditional vaccine strains and genotype VII viruses (Xiao et al., 2012). Genotype-matched vaccines have shown potential to reduce viral shedding more effectively while maintaining protection against clinical disease (Ji et al., 2018).

Continued molecular surveillance of circulating NDV strains is therefore important for

outbreak investigation, epidemiological monitoring, vaccine evaluation, and the development of improved vaccination strategies.

Conclusion

Newcastle disease remains an important poultry disease capable of causing substantial production losses, particularly when highly virulent strains are involved. Effective control requires an integrated approach involving appropriate vaccination, strict biosecurity, sanitation, disease surveillance, and timely diagnosis.

Although vaccination provides strong protection against clinical disease and mortality, vaccinated birds may still become infected and shed genetically different field strains under certain circumstances. Therefore, molecular surveillance and continued development and evaluation of suitable vaccine strategies are important components of modern Newcastle disease control.

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