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Newcastle disease

Disease Overview

Plan of Talk

- Introduction
- Etiology
- Epidemiology
- Transmission
- Clinical Signs
- Post Mortem Lesions

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Introduction

- Newcastle disease is defined as an infection of birds caused by a virus of avian paramyxovirus serotype 1 (APMV-1) that meets one of the following criteria for virulence:
  1. The virus has an intracerebral pathogenicity index (ICPI) in day-old chicks (Gallus gallus) of **0.7** or greater.
  2. The virus has multiple basic amino acids have been demonstrated in the virus at the:
     - C-terminus of the F2 protein.
     - N-terminus of the F1 protein, which is phenylalanine at residue 117.

Multiple Basic Amino Acids

- The term 'multiple basic amino acids' refers to at least 3 arginine or lysine residues between residues 113 to 116.

Molecular Basis of Pathogenicity of ND

- During replication, NDV particles are produced with a precursor glycoprotein, **F0**, which has to be cleaved to **F1** and **F2** for the virus particles to be **infectious** (Rott and Klenk 1988).
- This post translation cleavage is mediated by **host cell proteases** (Nagai *et al*. 1976a).
- **Trypsin** is capable of cleaving F0 for all NDV strains.

Cont. …

- The cleavability of the F0 molecule was shown to be related directly to the virulence of viruses *in vivo* (Rott, 1979; Rott, 1985).
- This allows these viruses to spread throughout the host, damaging vital organs.

Cont. ...

- Since the initial studies comparing the deduced amino acid sequences at the cleavage site of the F0 precursor of a number of virulent and avirulent ND strains (Collins *et al*, 1993), a large number of studies has confirmed the presence of multiple basic amino acids at that site in virulent viruses.

Cont. ...

- In highly virulent viruses, the sequence has been 113/RQK/RR ↓ F117.
- In contrast, viruses of low virulence usually have the sequence 113K/RQG/ER ↓ L117.

Cont. …

The major influence on the pathogenicity of NDV is:

The amino acid motif at the F0 cleavage site, the presence of basic amino acids at positions 113, 115 and 116 and phenylalanine at 117 in virulent strains means that cleavage can be effected by protease (proteases are present in a wide range of host tissues and organs)

Cont. …

- For low virulence viruses, cleavage can occur only with **proteases recognizing a single arginine**, i.e. trypsin-like enzymes.
- Such viruses are therefore restricted in the range of sites where they are able to replicate to areas with **trypsin-like enzymes**, such as the **respiratory** and **intestinal tracts**, whereas virulent viruses can replicate in a range of tissues and organs resulting in a fatal systemic infection (Rott, 1979).

Intra-Cerebral Pathogenicity Index

ICPI

Intra-Cerebral Pathogenicity Index

1. Fresh infective allantoic fluid with a HA titre >24 (>1/16) is diluted 1/10 in sterile isotonic saline with no additives, such as antibiotics.
2. 0.05 ml of the diluted fluid is injected intracerebrally into each of ten chicks (24-40 hrs age) hatched from eggs from SPF flock.
3. The birds are examined every 24 hours for 8 days.
3. At each observation, the bird is scored:
   a) 0 if normal.
   b) 1 if sick.
   c) 2 if dead.

Cont. ...

- The intracerebral pathogenicity index (ICPI) is the mean score per bird per observation over the 8-day period.
- The most virulent viruses will give indices that approach the maximum score of 2.0, whereas lentogenic and asymptomatic enteric strains will give values close to 0.0.

Examples Of ICPI Of Several NDV Isolates

Virus	Product	ICPI
Ulster 2C	Poulvac NDW	0.04 to 0.23
PHY.LMV.42	Cevac® VITAPEST L	0.16
Hitchner B_1	Many	0.18
Clone 30	Nobilis® ND Clone 30	0.25
VG/GA	AVINEW®	0.30
La Sota	Many	0.4
Komarov		1.41

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Etiology

- Newcastle disease (ND) is caused by specified viruse;
  - Serotype: avian paramyxovirus type 1 (APMV-I)
  - Genus: *Avulavirus*
  - Subfamily: Paramyxovirinae
  - Family: Paramyxoviridae.

Newcastle Disease Virus

- Based on the genetic relationship between viruses, APMV-1 isolates can also be separated into two clades;
  1. Class I
     - **Class I** isolates have been found mainly in **wild waterfowl**, and are usually of **low pathogenicity**.
  2. Class II
     - The vast majority of APMV-1 strains belong to **class II**, which is divided into at least **9 genotypes** (I to IX).

Cont. ...

- Members of this family have a single stranded, linear, RNA, with an elliptical symmetry.
- The total genome is roughly 16,000 nucleotides.
- Replication of the virus takes place in the cytoplasm of the host cell.
- The most important pathogen for poultry is the Newcastle disease virus, which is APMV-1.
- APMV-2, APMV-3, APMV-6, and APMV-7 also cause disease in poultry.

Criteria For NDV Pathogenicity

IVPI

Intra-Venous Pathogenicity Index

- For 6 weeks susceptible chicks.
- Minimal score = 0.0 for Lentogenic strains.
- Maximal score = 3.0 for Velogenic strains.

Cont. ...

MDT (Mean Death Time)

in 9 days embryonated chicken eggs.

Embryo mortality:

40 : 60 hours in Velogenic strains

60 : 90 hours in Mesogenic strains

> 90 hours Lentogenic starins

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Epidemiology

- Morbidity: up to 100%
- Mortality: 90%
  - Varies greatly depending on:
    - Virulence and strain.
    - Avian species and susceptibility of host.
    - Environmental conditions.
    - Vaccination history.

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Transmission

- APMV-1 can be transmitted by inhalation or ingestion (fecal/ oral route).
- Birds shed virus in both feces and respiratory secretions.
- Some birds excrete APMV-1 for 1-2 weeks.

Cont. …

- The virus survives for long periods in the environment especially in feces, and may be transmitted through:
  1. **Direct contact with:**
     a) Feces or respiratory secretions.
     b) Carcass of infected bird.
  2. **Indirect contact with contaminated;**
     a) Feed and water.
     b) Equipment.
     c) Human clothing.

Cont. …

- **Incubation period**
  - 2 to 15 days with average of 5 to 6 days, depending on severity of the strain and susceptibility of birds.

Human Transmission

- People can become infected with vNDV and show signs mild conjunctivitis;
  - It resolves quickly.
  - Virus shed in ocular secretions for 4-7 days.
  - Infected individuals should avoid contact with avian species during this period.
- Lab workers and vaccination crews most at risk.
- No cases from handling or consuming poultry products.
- No human-to-human spread.

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Clinical Signs

1. Numerous deaths within 24 to 48 hours.
2. Deaths continue for 7 to 10 days.
3. Drop in egg production.
4. Surviving birds may have neurological or reproductive damage.
5. Edema of head, especially around eyes.
6. Greenish, dark watery diarrhea.
7. Respiratory and neurological signs.

Cont. ...

8. Neurologic signs may include:
   a) Muscle tremors.
   b) Drooping wings.
   c) Dragging legs.
   d) Twisting of the head and neck, circling, depression, inappetence, or complete paralysis.

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Post Mortem Lesions

- There are no specific diagnostic post mortem lesions seen with ND.
- Gross lesions can be very similar to highly pathogenic avian influenza, so laboratory isolation and identification is important for a definitive diagnoses.

Cont. ...

- **Lesions may include:**
  1. Edema of the interstitial tissue of the neck, especially near the thoracic inlet.
  2. Congestion and sometimes hemorrhage on the trachael mucosa
  3. Petechiae and small ecchymoses on the mucosa of the proventriculus
  4. Edema, hemorrhage, necrosis or ulceration of lymphoid tissue in the intestinal mucosa including Peyer's patches
  5. edema, hemorrhages, or degeneration of the ovaries.
  6. Edema or necrosis of the cecal tonsil and lymphoid tissue of the intestinal wall is especially suggestive of ND.

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