**Newcastle Disease (ND)**

**Extended Version**

**Classic case:** Gasping, facial edema (‘square head’), paralysis, ↓ egg production, sudden death

**Presentation:** Acute, highly contagious, **respiratory** and **neurologic** disease of **ALL** avian species

- Poultry (CHICKENS, young) most seriously impacted
- Wide range **clinical signs** dependent on **strain, predilection & virulence**
  - From peracute w/ almost **100% mortality**
  - To **subclinical** w/ NO lesions

**Five strains grouped by pathotype**

1. **Viscerotrophic velogenic Newcastle disease (VVND): Reportable**
   - Highly virulent, ~100% mortality in 2-3 days
   - **Respiratory**
     - Marked gasping, coughing, wheezing
     - Sneezing, nasal discharge
     - Facial edema- ‘Square head’
     - Reddened lower eyelid (over lymphoid patch)
   - **Neurologic** (encephalitis)
     - Muscle tremors, droopy wings, opisthotonus, circling, paralysis, torticollis
   - **Digestive**
     - Inappetence, violent watery green diarrhea
   - Depression, fever, ruffled feathers
   - **Decreased** egg laying
     - Eggs: thin shells, watery albumen,
     - Abnormal color, shape
   - **Sudden death**

2. **Neurotropic velogenic: Reportable**
   - Highly virulent, ~100% morbidity, 50% mortality
   - +/- Respiratory signs followed by **neurological** signs
     - Muscle tremors, droopy wings, opisthotonus, circling, paralysis, torticollis
     - Bright & alert even with severe nervous signs
     - Will eat if able to reach food

3. **Mesogenic: Reportable**
   - Moderate virulence, low mortality
   - **Young** chicks (up to 50% mortality)
     - Gasping, coughing, hoarse chirping
     - Ataxia, ‘star gazing’
   - **Adults**
     - Mild depression & **respiratory signs**, nervous signs (rare)
     - Decreased egg production, Abnormal eggs
     - Increased morbidity due to secondary infections
Newcastle Disease (ND)

**Presentation:** Five strains grouped by pathotype (continued)

4. **Lentogenic:** NOT reportable Used for modified-live vaccines
   - Low virulence, RARELY causes disease in adults
   - Mild or subclinical respiratory infection
   - Decreased egg production

5. **Asymptomatic enteric:** NOT reportable
   - Subclinical enteric infection

**DDX:**
Avian influenza, fowl cholera, infectious bronchitis, ILT

**Test(s) of choice:** Reportable disease
- **Field Diagnosis** - Clinical signs, necropsy
- **Necropsy**
  - **Viscerotropic velogenic** - Remarkable gross lesions
    - **Almost pathognomonic** - Multifocal, necrosis, hemorrhage intestinal mucosa, especially at lymphoid foci (cecal tonsils)
    - Hemorrhage & necrosis of **lymphoid organs**
      - Spleen, GALT, cecal tonsils, thymus, laryngeal tonsils
    - Edema, hemorrhage, petechiations, ecchymoses
      - Serous membranes, mucosa
      - Proventriculus, intestines, eyelid, comb, wattle
      - Cranial trachea (laryngeal tonsils), peri-thymic region
    - Severe atrophy of thymus and bursa of Fabricius
  - **Neurotropic velogenic** - NO gross lesions
  - **Mesogenic and Lentogenic** - Minimal gross lesions
    - Lesions primarily due to secondary bacterial infections
    - Mild tracheal and pulmonary hemorrhages
    - Splenomegaly
    - Respiratory tract congestion & mucoid exudate
    - Cloudy, thickened air sacs

**Splenic edema and necrosis (white spots), NVND**

**Multifocal, necrosis & hemorrhage of intestinal mucosa, especially at lymphoid foci (cecal tonsils). Almost pathognomonic for NVND**

**Proventriculitis with hemorrhages concentrated at esophageal-proventricular junction. Common finding. NVND**
Newcastle Disease (ND)
Extended Version

Test(s) of choice: (continued)

- **Histopathology**
  - **Viscerotropic velogenic**
    - Severe necrosis & depletion of all lymphoid tissues
  - **Neurotropic velogenic**
    - Cerebellum (molecular layer) - gliosis
    - Lymphoid depletion
    - Myocarditis
  - **Mesogenic** MOST severe CNS lesions in Pigeon-isolated strains
    - Cerebellum & medulla oblongata (primarily) - encephalitis
    - Myocarditis, splenic, pancreatic necrosis
  - **Lentogenic** - Minimal changes
    - Hyperplasia - lymphoid follicles, spleen, lungs, air sacs, trachea
    - Respiratory tract - deciliation, congestion, edema, goblet cell hyperplasia, squamous metaplasia in proximal trachea

- **Virus isolation:** “Gold Standard”
  - Prescribed test for international trade (OIE)
  - Using chick embryos or cell culture
  - Tested for hemagglutination activity (HA) on chicken erythrocytes
    - **Positive HA** - key feature of NDV and Avian Influenza
    - **Infectious bronchitis** = **negative HA**
    - Helps **differentiate** diseases
  - **IF** positive HA
    - Hemagglutination inhibition (HI) tests - ID pathotype & genotype
    - RT-PCR, nucleotide sequence analysis, monoclonal antibodies - detects genetic differences to compare with past outbreaks & ID source of infection
  - Specific amino acid motif of fusion (F protein) “notifiable” to OIE due to virulence

- **ICPI (intracerebral pathogenicity index) test**
  - Most sensitive, widely used test for measuring virulence
  - Measured by rapidity of killing day-old chicks inoculated intracerebrally
  - ICPI ≥ 0.7 is considered virulent or “notifiable” to the OIE

Rx of choice: **NO** treatment
- **CULL** all birds on premises of NDV outbreak
Newcastle Disease (ND)

Prognosis:
- High losses with devastating economic ramifications
  - High mortality (with highly virulent strains like VVND)
  - Trade restrictions
  - Decreased production
  - Culled poultry flocks

Prevention:
- Vaccination:
  - **DOES NOT** fully protect against NDV
  - Can obscure signs of NDV resulting in further spread
  - **Modified-live lentogenic vaccines:**
    - Mass application
      - Drinking water (chicks)
      - Coarse spray (hatchery)
    - Individual administration
      - Nares
      - Conjunctival sac
    - Contraindicated in pigeons
  - **Oil-adjuvanted killed vaccines:**
    - Safe in pigeons
- Strict biosecurity and strict sanitation protocols
- "All-in, All-out" flock management
- Prevent healthy birds from contact w/ sick birds or wild birds
- Only incubate eggs from clean flocks
- Enforce stringent importation laws

Pearls:
- Newcastle disease virus (RNA virus): **Avian Paramyxovirus** Serotype 1 (APMV-1)
- **Strain variation**- differences in surface glycoproteins
  - Hemagglutinin-neuraminidase (HN)
  - Fusion (F)
- Virus shed during incubation, clinical stage, AND convalescence
- Viable in environment for **weeks**
  - Feathers, secretions, droppings
  - Survives indefinitely in frozen material
  - Rapidly destroyed by dehydration & UV rays
  - Present in eggs laid during clinical disease

Non-poultry avian species (e.g. pigeons, parakeets, parrots) usually resist early lethal infection & develop chronic neurologic disease instead.

Neurologic signs predominate regardless of pathotype. This bird is exhibiting torticollis.
**Pearls: (continued)**

- Sometimes called “Exotic Newcastle disease” (END)

*Transmission*: high levels of virus in body secretions
  - **Direct contact**
    - Bird to bird
    - Contaminated food, water, feces
  - **Airborne**
  - **Fomites**

**ZOONOTIC**

- NDV can produce *transitory conjunctivitis in people*
  - Lab workers & vaccination teams (high exposure to virus)
  - Poultry processing crews (less common due to vaccination)


Images courtesy, Atlas of Avian Diseases, Cornell University

**My Notes:**