Avian Influenza (Highly Pathogenic)

Fowl plague, Fowl pest,
Brunswick bird plague,
Fowl disease, Fowl or bird grippe

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Overview

- Organism
- Economic Impact
- Epidemiology
- Transmission
- Clinical Signs
- Diagnosis and Treatment
- Prevention and Control
- Actions to take

The Organism

Influenza Virus

- Family Orthomyxoviridae
- Three main types
  - Type A
    - Multiple species
  - Type B
    - Humans
  - Type C
    - Humans and swine

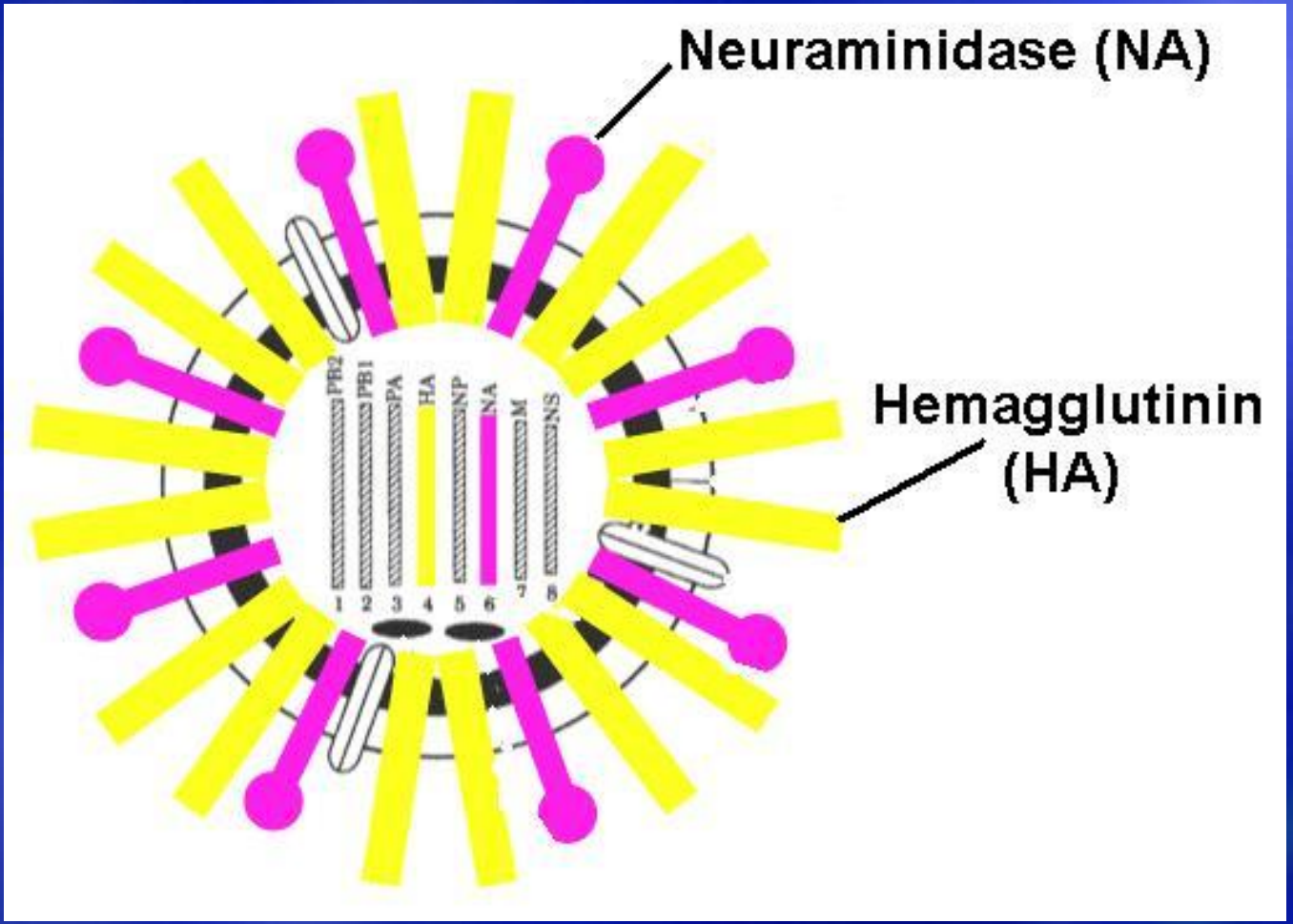
Influenza A

- Multiple species
  - Humans
  - Avian Influenza
- Most virulent group
- Classification by surface antigens into subtypes
  - Hemagglutinin (H or HA)
  - Neuraminidase (N or NA)

Surface Antigens and Subtypes

- 15 HA and 9 NA for influenza A
  - All in aquatic birds
- Hemagglutinin (HA)
  - Function: Sites for attachment to infect host cells
- Neuraminidase (NA)
  - Function: Remove neuraminic acid from mucin and release from cell

Influenza A


Neuraminidase (NA)
Hemagglutinin (HA)
PB2
PB1
PA
HA
NP
NA
M
NS
1 2 3 4 5 6 7 8

Influenza B

- Mostly humans
- Common
- Less severe than A
- Epidemics occur less often than A
- Human seasonal vaccine
  - Two strains of type A
  - One strain of type B

Influenza C

- Humans and swine
- Different pattern of surface proteins
- Rare
  - Mild to no symptoms
- By age 15, most have antibodies

Avian Influenza

- Pathogenicity based on genetic features and/or severity of disease in poultry
  - Low pathogenic AI (LPAI)
    - H1 to H15 subtypes
  - Highly pathogenic AI (HPAI)
    - Some H5 or H7 subtypes
    - LPAI H5 or H7 subtypes can mutate into HPAI

Importance

History

- 1878: First identified case in Italy
- 1924-25: First U.S. cases
- Low pathogenic avian influenza first identified mid-twentieth century
- 1970's: Migratory waterfowl carriers
- Outbreaks in mink, seals and whales

Economic Impact

- Direct losses:
  - Depopulation and disposal
  - High morbidity and mortality
  - Quarantine and surveillance
  - Indemnities
- 1978-2003: Seasonal outbreaks of LPAI in Minnesota cost growers $22 million

Economic Impact

- 1983: U.S. outbreak (H5N2)
  - $65 million in losses
  - Destruction of 17 million birds
  - 30% increase in egg prices
- 1999-2000: Italy outbreak (H7N1)
  - $100 million in compensation to farmers
  - 18 million birds destroyed
  - Indirect losses of $500 million

Economic Impact

- 1997: Hong Kong outbreak (H5N1)
  - $13 million for depopulation and indemnities
  - 1.4 million birds
- 2001: Hong Kong outbreak (H5N1)
  - 1.2 million birds
  - $3.8 million

Economic Impact

- 2003: European outbreak (H7N7)
  - Over 33 million birds destroyed
  - ¼ of Netherlands' poultry stock
  - Cost?
- 2003-2004: SE Asia (H5N1)
  - 8 countries
  - >100 million birds destroyed
  - Cost?
- 2004-2005: SE Asia and Eurasia
  - Spread to Eurasia by migratory birds

Epidemiology

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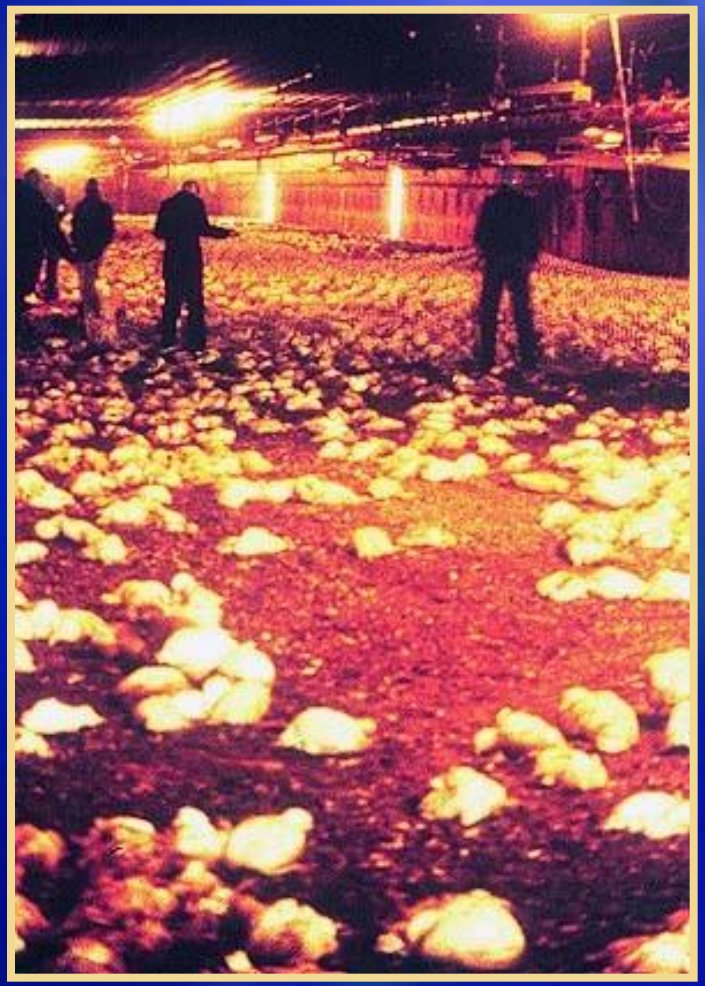
Geographic Distribution

- Worldwide distribution
- Reservoir
  - Free flying aquatic birds: Ducks, geese, shorebirds, gulls, terns, auks
- Recent outbreaks
  - The Netherlands, Australia, Mexico, U.S., SE Asia, Eurasia
- Similarity to Newcastle Disease makes actual distribution difficult to define
- Altered avian ecosystems have created new niche for AI viruses

Morbidity/Mortality

- Approaches 100% in commercial poultry flocks
- Deaths within 2 to 12 days after first signs of illness
- Survivors in poor condition



Transmission

Animal Transmission

- Initial source of infection
  - Other poultry, migratory waterfowl, pet birds
- Spread by aerosol, shared drinking water, fomites
- Virus in respiratory secretions and feces
- Virus present in eggs but eggs unlikely to survive and hatch

Human Transmission

- Previously considered non-pathogenic for humans
- 1997, Hong Kong
  - 18 humans infected, 6 died
  - H5N1 virus linked to outbreak in live bird market and area farms
- 2003, the Netherlands
  - 83 confirmed cases in humans, 1 death
  - H7N7 strain

Human Transmission

- 2004-2005, SE Asia
  - 118 cases, 61 deaths
    - Indonesia, Viet Nam, Thailand, Cambodia
  - H5N1 strain
  - Within the vicinity of poultry outbreaks
  - Evidence for human-to-human transmission
- Role of swine
  - Proposed “mixing vessel”

Animals and Highly Pathogenic Avian Influenza

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Clinical Signs

- Incubation period: 3-14 days
- Birds found dead
- Drop in egg production
- Neurological signs
- Depression, anorexia, ruffled feathers
- Combs swollen, cyanotic
- Conjunctivitis and respiratory signs

Post Mortem Lesions

- Lesions may be absent with sudden death
- Severe congestion of the musculature
- Dehydration
- Subcutaneous edema of head and neck area

Post Mortem Lesions

- Nasal and oral cavity discharge
- Petechiae on serosal surfaces
- Kidneys severely congested
- Severe congestion of the conjunctivae

Sampling

- Before collecting or sending any samples, the proper authorities should be contacted
- Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease
- HPAI samples may be zoonotic

Diagnosis

- Clinically indistinguishable from virulent Newcastle Disease
- Suspect with:
  - Sudden death
  - Drop in egg production
  - Facial edema, cyanotic combs and wattles
  - Petechial hemorrhages
- Virology and serology necessary for definitive diagnoses

Differential Diagnosis

- Virulent Newcastle disease
- Avian pneumovirus
- Infectious laryngotracheitis
- Infectious bronchitis
- Chlamydia
- Mycoplasma
- Acute bacterial diseases
  - Fowl cholera, *E. coli* infection

Diagnosis

- Laboratory Tests
  - HP AI is usually diagnosed by virus isolation
- Presence of virus confirmed by
  - AGID
  - ELISA
  - RT-PCR
- Serology may be helpful

Treatment

- No specific treatment
- Supportive care and antibiotics for secondary infections
- Antivirals (amantadine) effective in reducing mortality
  - Not approved in food animals
  - Results in resistant viruses

Avian Influenza in Humans

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Clinical Signs in Humans

- 1997: Hong Kong (H5N1)
  - Fever, respiratory, vomiting, diarrhea, pain
  - Fatal cases: severe bilateral pneumonia, liver dysfunction, renal failure, septic shock
- 1979: MP AI in harbor seals (H7N7)
  - Conjunctivitis in humans in contact

Clinical Signs in Humans

- 2003: Netherlands (H7N7)
  - Conjunctivitis
  - Mild influenza or respiratory symptoms
  - Fatal case: acute respiratory distress syndrome
- 2004-2005: S.E. Asia, EurAsia

Public Health Significance

- Risk is low
- Strains vary in ability to infect humans
- High occupational exposure may increase risk
- 2003: 83 cases
  - Human infections from non-compliance with personal biosafety measures
  - Evidence of human-to-human transmission

Prevention and Control

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Recommended Actions

- Notification of Authorities
  - Federal Area Veterinarian in Charge (AVIC) www.aphis.usda.gov/vs/area_offices.htm
  - State Veterinarian www.aphis.usda.gov/vs/sregs/official.htm
- Quarantine

Recommended Actions

- Confirmatory diagnosis
- Depopulation may occur
  - Infected premises
  - Contact-exposed premises
  - Contiguous premises

Control and Eradication

- Eliminate insects and mice
- Depopulate flock and destroy carcasses
- Remove manure down to bare concrete
- High pressure spray to clean equipment and surfaces
- Spray with residual disinfectant

Prevention

- Import restrictions
- Surveillance
- Appropriate biosecurity
  - Control human traffic
  - Introduction of new birds into flock
  - Avoid open range rearing in waterfowl prevalent areas
- Education of the poultry industry
- Prompt response to MP AI outbreaks

Influenza Vaccine Development

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Avian Influenza Vaccine

- Traditional killed vaccines are effective
- Vaccines will protect only against other avian influenza viruses with the same hemagglutinin (H) type.

Influenza A Viruses

- Mutate frequently
  - Antigenic drift
    - Point mutations accumulated during virus replication
  - Antigenic shift
    - Hybrid virus emerges when cell infected with two different influenza viruses
      - Human, avian, swine, equine
    - Transfer of influenza virus to a different species

Influenza A Viruses

Human influenza vaccines

- Antigenic drift
  - Requires new strains to be used in vaccines each year
- Antigenic shift
  - Caused pandemics in 1918, 1957, 1968, and ?
- Current human influenza vaccines have no efficacy against avian influenza

Vaccination

- Drawbacks to vaccination
  - Expensive
  - No cross protection between 15 H subtypes
  - Possible creation of reassortant virus
- Inactivated H5 and recombinant vaccine licensed in the U.S. for emergency in HPAI outbreaks

Additional Resources

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Internet Resources

- World Organization for Animal Health (OIE)
  - www.oie.int
- USAHA Foreign Animal Diseases – "The Gray Book"
  - www.vet.uga.edu/vpp/gray_book/index
- World Health Organization
  - www.who.int

Additional Resources

- CDC – Centers for Disease Control and Prevention
  - Avian influenza (bird flu) home page
    - www.cdc.gov/flu/avian
- U.S. Department of Agriculture
  - Biosecurity for the birds
    - www.aphis.usda.gov/vs/birdbiosecurity
  - Avian influenza
    - www.aphis.usda.gov/vs/birdbiosecurity/hpai.html

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