Outline

- Introduction
- Causitive agent(s)
- Economic Impact
- Transmission
- Clinical Signs
- Diagnosis and Treatment
- Prevention and Control

Avian Influenza

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Introduction

- Type A influenza viruses can infect both mammals including humans, pigs, horses, cats, dogs, ferrets, and sea mammals as well as domestic and wild birds.
- Although influenza A viruses shows host range restrictions, interspecies transmission have been documented at many occasions.

Introduction

- Influenza is a highly contagious disease causing serious health and economic threats to both humans and animals worldwide
- AI is naturally found in wild birds
- All type AI viruses are thought to originate from wild birds

Influenza Nomenclature

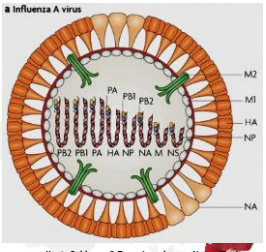
A/Chicken/Pennsylvania/1370/83 (H5N2)

1 2 3 4 5 6 7

1) Antigenic type
2) Isolate host of origin
3) Geographic location
4) Isolate reference
5) Year of isolation
6) Hemagglutinin subtype
7) Neuraminidase subtype

Etiology

- Belongs to the family ***Orthomyxoviridae***
- Single-stranded, negative-sense enveloped RNA virus
- 8 segmented genes encoding at least 10 proteins
- Typed based on internal proteins: NP or M1:
  - Influenza A, Influenza B, Influenza C, Isavirus and Thogotovirus
- **Influenza A virus** : subtyped based on surface proteins: 17 HA and 10 NA subtypes



Kanta Subbarao & Tomy Joseph.2007. Nature Reviews Immunology 7, 267-278

Antigenic Drift

- Antigenic 'drift' occurs in HA and NA and induced by:
  - Vaccination pressure: the virus produce escape mutants
  - Influenza virus genes, made of RNA, are more prone to mutations than genes made of DNA.
  - HA gene changes, cause change of HA shape

Antigenic Shift (Reassortment of Gene Segments)

- Influenza has 8 separate gene segments that encode 10 different proteins
- When a host cell is infected with two different influenza viruses, the progeny virus can be a mixture of both “parent” viruses
- Reassortment provides for increased biological variation that increases the ability of the virus to adapt to new hosts

Emergence of HPAI

LPAI H5 or H7 virus transmitted to poultry

LPAI virus circulates in poultry with mild disease

LPAI Virus Mutates to HPAI with severe disease

AI Pathotypes

- In all AI viruses, the haemagglutinin produced as a precursor, HA0, which requires post-translational cleavage by host proteases. Based on this AI divided into:

A. LPAI: where the HA0 precursor proteins has limited cleavage by host proteases such as trypsin-like enzymes and thus restricted replication i.e. the respiratory and intestinal tracts.

B. HPAI: e.g. H5 and H7 HPAI: viruses possess multiple basic amino acids at the HA0 cleavage sites, and are cleavable by ubiquitous proteases, so they are able to replicate throughout the bird

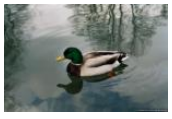
Waterfowl- Reservoir

- Most HA and all NA subtypes have been found in wild waterfowl
- The distribution of subtypes is not uniform-H6, H3, and H4 tend to predominate in North America
- Some important influenza hemagglutinin subtypes are found uncommonly in birds, including H5 and H7
- The distribution of hemagglutinin subtypes differ from year to year at the same location

AI Ecology

Blue Wing Teal

Mallards



Herring Gulls

- ❑ Virus infection is not normally thought to cause disease in its natural host (Viruses are low pathogenic)
- ❑ Certain duck, gull, and shorebirds species are commonly infected at different times of the year
- ❑ All type A influenza viruses are thought to originate from wild birds

Hosts restrictions

- AI viruses have been shown to infect birds and mammals
- The main factors that influence susceptibility to infection is the receptor conformation on the host cells.
  - Avian type: sialic acid (SA)-α2,3- Gal-terminated saccharides
  - Human type: SA-α2,6-Gal-terminated saccharides
- However, this barrier is not insurmountable.

Avian Influenza in Poultry

- AIV is not normally found in domestic ducks, chickens and turkeys
- Transmission of AIV from wild birds to domestic poultry species occurs commonly (ducks>turkeys> chickens)
- AIV on rare occasions may become established in chickens and turkeys and result in serious disease outbreaks
- AIV once adapted to chickens and turkeys can be difficult to eradicate

Transmission

- Transmission from bird to bird occurs as a result of close proximity between infected and naive hosts.
- Direct contact with infected birds or with contaminated exudates or droppings are necessary for transmission
- This also indicates that airborne spread over large distances is an unlikely event.

Transmission

- Bird-to-bird transmission is extremely complex and depends on:
  - the strain of virus,
  - the species of bird
  - environmental factors.
- In both natural and experimental infections:

HPAI are poorer transmitted than LPAI . Because spread related to the amount of virus released by the respiratory or intestinal route.

Clinical signs-LPAI

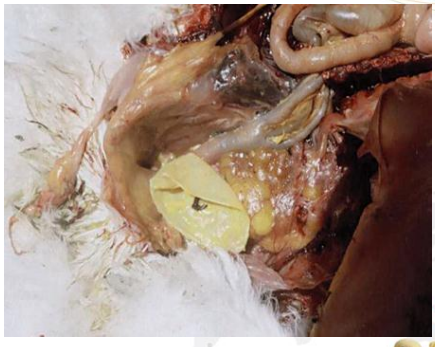
❑ **Turkeys** :

- Highly susceptible
- In pullets, LPAI infections cause anorexia and respiratory distress (rales, snicking and light coughing, and swelling of infraorbital sinuses)
- Significant mortalities may be observed
- Drastic drops in egg production is big problem

Clinical signs-LPAI

❑ **Chickens**:

- Less susceptible than turkeys
- In broiler chickens, LPAI infections are often in-apparent and, when present, can be confused with other conditions.
- Anorexia and mild respiratory distress (rales, snicking and light coughing,
- Some LPAI viruses have been reported to cause serious health problems in broilers. e.g. H9N2 subtype and significant mortality (upto 50%)
- In laying birds: eggs are misshapen and/or with loss of colour may be laid in significant quantities.



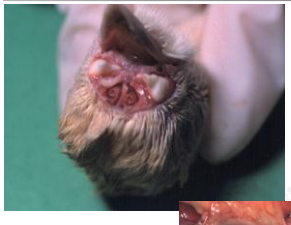
Lesions

- Chickens:
  - Mild and restricted pulmonary and tracheal congestion
  - Extensive hyperaemia of the respiratory system
  - In broiler breeders, Ovarian follicles often appear haemorrhagic, oedematous and colliquated. The oviduct may be oedematous, with catarrhal or fibrinous egg-yolk peritonitis
  - Mild pancreatitis is occasionally seen.
- Turkeys:
  - Caseous clot in the sinuses and trachea, which may cause suffocation.
  - Edematous trachea and lungs and congested
  - Fibrinous air sacculitis
  - The spleen is often enlarged and congested

Clinical signs-HPAI

❑ **Chickens**:

- Highly susceptible
- The transmission is very fast (litter system) and flock mortality may be as high as 100%
- Anorexia, depression and cessation of egg-laying in breeders
- Nervous signs, characterized by prostration, complete reluctance to move, tremors of the head, paralysis of the wings and incoordination
- Cyanosis of the comb and wattles
- Haemorrhages on the shank
- Sudden death occurs in a recumbent position and is preceded by pedalling movements and gasping.



Clinical signs-HPAI

❑ **Turkeys**:

- Some birds found dead prior to any clinical signs.
- 100% flock mortality may be observed
- Sudden and dramatic drop in food consumption
- Nervous signs, mainly tremors and incoordination. The birds exhibit shaking of the head, paralysis of the wings, abnormal gait
- Dramatic and acute nature of the nervous signs

Clinical signs-HPAI



Lesions

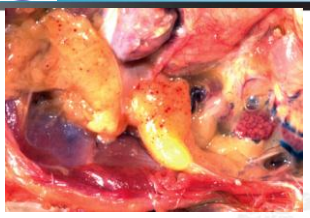
- **Chickens:**
  - Congested internal organs
  - Swelling of the head and upper neck
  - Haemorrhages and cyanosis of the skin (wattles, combs and legs)
  - Haemorrhages on serosal or mucosal surfaces and abdominal fat
  - Haemorrhages on the epicardium, pericardium
  - Pancreas: focal to diffuse necrosis of the acinar cells.
  - The lungs and trachea are congested

Clinical signs-HPAI


Lesions

- **Turkeys:**
  - Congested internal organs
  - Peracute nature of the disease no gross lesions
  - Haemorrhages on serosal or mucosal surfaces and foci of necrosis within parenchyma of visceral organs.
  - Pinpoint haemorrhages are seen on the epicardium.
  - Congestion and necrosis

Lesions

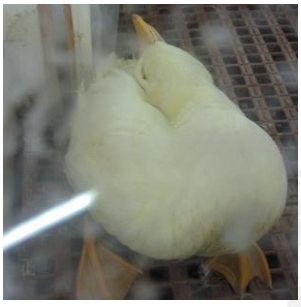


In ducks and geese

- **Clinical signs**
- Enlarged nerves and lymphoid tumors in various viscera.
- The absence of bursal tumors helps distinguish this disease from lymphoid leukosis
- Marek's disease can develop in chickens as young as 3 wk old
- Histology
- Histochemistry and PCR, respectively.

Lesions


In ducks and geese



In ducks and geese

- **Clinical signs**
- Ducks and geese are known to be more resistant
- In some cases causing > 50% mortality.
- Muscovy ducks exhibit nervous signs such as incoordination and tremors
- Pekin ducks are also considered to be resistant clinically
- Clinical signs include conjunctivitis and mild depression, followed by nervous signs such as torticollis, incoordination, tremors and seizures

In ducks and geese

In ducks and geese

- **Lesions**
- Stomach and gizzard
- Haemorrhages on the surface of the pancreas and trachea and air sacculitis
- Hyperaemia and pinpoint haemorrhages may be found on the surface of the brain
- Pancreatitis

Diagnosis

Virus Isolation

- **Samples – any (tissue, swabs)**
- **Advantages**
  - Gold standard
  - Sensitive – all subtypes
- **Disadvantages**
  - Expensive and labor intensive
  - False negatives (sample mishandling)
  - Special facilities needed

Diagnosis

- **Serologic Diagnosis**

  AGID, ELISA, HI, NI
- **Virus isolation**

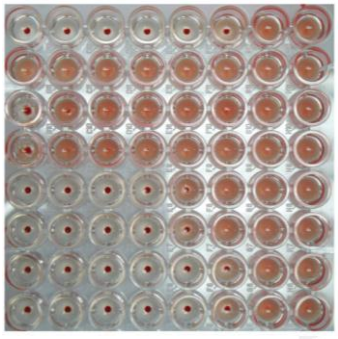
  Allantoic sac inoculation then HA
- **Antigen capture**
- **Molecular diagnostics**

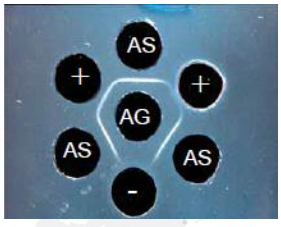
  RT-PCR & Real-time rt-PCR

Prevention and control

- **Stamping out**-identify infected flocks and destroy them to prevent spread to other flocks
- **Vaccination** in conjunction with **stamping out**
- **Vaccination** only

Diagnosis



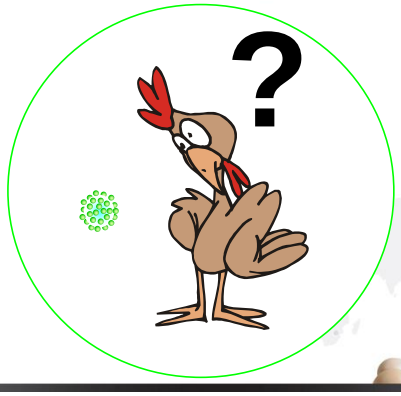


To Vaccinate or Not To Vaccinate

- Vaccines will prevent clinical disease, but not infection
- Good vaccines, properly administered, can reduce virus shedding from infected birds and reduce chance of virus spread
- Vaccines will adversely affect export markets
- Costs of vaccination are not insignificant
- Bad vaccines may contribute to virus spread

Stamping Out

- This has been the method used in the U.S. for most foreign animal diseases including Avian Influenza
- Requires both good veterinary infrastructure and a diagnostic network
- Can be the most cost effective if outbreaks identified early
- Approach not practical when a disease is widespread in the country



Vaccination

- Proper vaccination programs must also include good surveillance, education, quarantines and animal movement controls
- Vaccination can be used to reduce the susceptible population, and when used with stamping out may be an effective tool
- Vaccination without the proper controls may reduce disease, but will not eliminate it