Changing dimensions of Fowl Adenovirus in India and the concepts to control

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Changing Dimensions of “Poultry Health”

Genetics

Nutrition

Husbandry

Animal Welfare

Disease management

Rich History of BV300 and VenCobb 400/430

Ideal Balanced Diet

Doesn’t happen by accident

Most Vaccinated Species in the World
Changing Poultry Disease Threats in India

- Neoplastic
  - ALV / REV
  - MDV
  - IBDV

- Immunosuppressive
  - CAV
  - Reovirus
  - Adeno
  - Astrovirus
  - NDV
  - IBV

- Bacterial
  - Salmonella
  - FC
  - IC
  - ORT
  - AE
  - Pox

- Nephropathogenic
  - ILTV
  - Influenza
  - NDV
  - IBV

- Respiratory
  - AE
  - Pox
  - ILTV
  - Influenza
### Challenges To The Poultry Industry For Control

<table>
<thead>
<tr>
<th>Disease complexes</th>
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<tbody>
<tr>
<td>- Respiratory diseases</td>
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<tr>
<td>- Immunosuppressive diseases</td>
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<thead>
<tr>
<th>Complex diversity of RNA viruses</th>
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<tbody>
<tr>
<td>- Segmented RNA Viruses - Avian influenza, Reoviruses</td>
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<tr>
<td>- Single stranded RNA viruses - IBV, NDV</td>
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<tr>
<td>- Double stranded segmented RNA - IBDV</td>
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<thead>
<tr>
<th>Vertically transmitted diseases</th>
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<tbody>
<tr>
<td>- Viruses: ALV, Adenovirus, Astrovirus, AE, CAV, Reovirus,</td>
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<tr>
<td>- Bacteria: Mycoplasma, Salmonella, ORT</td>
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<tr>
<th>Indiscriminate use of Live vaccines</th>
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<th>Complex Vaccination schedules</th>
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<tr>
<td>- Vaccines should be used as prophylactic not therapeutic</td>
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</table>
Complex Respiratory Diseases

Environmental Factors aggravating the Disease

Opportunistic pathogens

- E. coli
- NDV
- IBV
- ORT
- Staph/Strep
- C. jejuni
- AI
- aMPV?
- REO
- ILTV
- Adeno
- Av. paragallinarum

Factors:
- Temperature
- Ventilation
- Ammonia
- Dust
- Humidity
Immunosuppressive Disease Complex

1976: Fadly et al.: Co-infection of Adenovirus with IBDV

1986: v.Bülow et al.: Adenoviruses increase after co-infection with CAV
Fowl Adenovirus Infections

A Primary Pathogen in Chickens?

A Subclinical infection?
Adenoviridae

- **Adenovirus** were first recovered from explants of human adenoid tissue (adeno gland).

- Adenoviruses infect a wide variety of mammals and birds and replicate in endothelial cells, e.g. kidney, liver, respiratory mucosa.

- Most disease self-limiting, lasts ~ 2 weeks

- Virus Characteristics:
  - non-enveloped, Icosahedral
  - Linear dsDNA of 30-38 kbp
New genus: Ataadenovirus
### Classification of Fowl adenovirus serotypes (1-12)

<table>
<thead>
<tr>
<th>Species</th>
<th>Serotype number</th>
<th>Type strain</th>
<th>Europe</th>
<th>USA</th>
<th>ICTV</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>CELO</td>
<td>1</td>
<td>1</td>
<td>I12, Ote, H1, CELO, QBV</td>
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<tr>
<td>B</td>
<td>5</td>
<td>340</td>
<td>8</td>
<td>5</td>
<td>TR-22, 340, TIPTON, M2</td>
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<tr>
<td>C</td>
<td>4</td>
<td>KR5</td>
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<td>4</td>
<td>506, H2, K31, 61, J2, KR5, M11, CFA20, SA2, C2B</td>
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<tr>
<td></td>
<td>11</td>
<td>C2B</td>
<td>10</td>
<td>10</td>
<td>-</td>
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<tr>
<td>D</td>
<td>2</td>
<td>GAL-1</td>
<td>2</td>
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<td>685, SR-48, H3, GAL-1, P7</td>
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<td></td>
<td>3</td>
<td>SR49</td>
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<td>75, H5, SR49</td>
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<td>90, CFA19, A2</td>
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<td>12</td>
<td>380</td>
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<td>11</td>
<td>UF-71, 380</td>
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<td>E</td>
<td>6</td>
<td>CR119</td>
<td>5</td>
<td>6</td>
<td>168, CR119</td>
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<td></td>
<td>7</td>
<td>TR36/X11</td>
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<td>7</td>
<td>YR-36, 122, X-11</td>
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<td></td>
<td>8</td>
<td>TR59</td>
<td>6</td>
<td>8a</td>
<td>58, CFA40, TR59, T-8</td>
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<tr>
<td></td>
<td>9</td>
<td>764</td>
<td>7</td>
<td>8b</td>
<td>VRI-33, 764, B3</td>
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</table>
Note:
A special problem that has been addressed, but not resolved is the lack of consensus in the numbering of the individual serotypes.
Epidemiology and Pathogenesis

- Ubiquitous in chickens: Demonstrated by serological and virological studies in sick and healthy birds.

- **Horizontal Transmission:** Related with Immunosuppression

  - **Aerosol spread**
    - With in the farms
    - But between farms is highly unlikely

  - **Excreted in high titers in the feces**
    - Contaminated poultry litter from a depopulated house

  - **Secretions and excretions:**
    - Nasal and tracheal mucosa, conjunctiva and kidneys

  - **Semen**
    - Important when artificial insemination is used.
Vertical transmission is very important in spread.

**Infected chicks**
- Approx. >3d-18-20 d
- Do not excrete until 2-4 wks of age or until maternal antibodies decline.

**Massive interchange of strains**
- Chicks from different parent flocks (Breeds): concurrent infections of one bird with 2-3 serotypes

**Layer replacement flock**
- Virus excretion maximum at 5-9 wks.

**Latency**
- When all breeders seroconvert shedding stops-vertical transmission stops
- Re-excrete virus throughout life, and aggravated during stress.
Avian adenoviruses and the diseases associated

- **Respiratory, Intestinal**
  - Respiratory disease, diarrhoea
  - Detrimental effects on FCR and arthritis

- **Reproductive - Egg drop syndrome**

- **IBH (inclusion body hepatitis)**

- **Hydropericardium syndrome**
  - Popularly called as ‘Litchi heart disease’ in broilers

- **Gizzard Erosion**

- **Chick Embryo Lethal Orphan (CELO) virus**

- **Quail bronchitis virus**

- **Undefined aetiology**
Egg-drop syndrome’76

First in laying birds, 1976 in Europe

Genus: ATadenovirus.
  - High ‘AT’ content in the genome

Strains
  - Several genotypes but only one serotype

Clinical signs
  - Reduced egg production up to 40% for 4-10 wks; soft-shelled, thin-shelled, shell-less eggs

Histology
  - Virus replication in the pouch shell gland
Inclusion body hepatitis

“The 3 days disease”

- First described in 1960’s in USA
- 3d increase Mortality, 3d Plateau and 3d Drop in mortality.
- Mortality up to 30%.

Disease

- Meat producing birds between in 3-7 wks.
- Liver is primary organ affected.
- With Co-infection with CAV and IBDV, target organ is haemopoietic system.
- PM: liver is swollen, light brown to yellow with hemorrhages, marked anemia, icterus of skin, fat deposits and haemorrhages in various organs, pale inactive bone marrow
Serotypes associated with outbreaks of IBH

Common serotypes prevalent around the World
- Serotype 2, 8b, 9, 11

Australia
- Serotype 6, 7 and 8 belonging to Group E

New Zealand
- Principally F8 and also F1 and F12 belonging to Group E
- In addition to liver lesions, atrophy of bursa and thymus, with aplastic bone marrow

Canada
- FAV-8 of Group E and FAV-11 of Group D

Europe
- FAV-2 of Group D

India
- FAV-4 of Group C, FAV-11 of Group D and FAV-8 of Group E
Associated with CAV in layers

- Necrotising pancreatitis
- Proventriculitis
- Gizzard erosions and/or ulcerations

Rule out: Mycotoxins, Biogenic Amines (Histamine, Gizzerosine etc), Vitamin B6 deficiency
Hydropericardium syndrome

**History**
- Subsequently recognised in India, Kuwait, Iraq, Mexico, Central and South America, Japan and Russia.

**Disease**
- Meat type birds between 3 -6wks, with mortality from 20-80%.
- Breeding and laying flocks with low mortality
- PM:
  - Enlarged pericardial sac, thickened and filled with straw colored fluid which is characteristic.
  - Liver is pale and enlarged and there is accumulation of fluid in the abdominal cavity.
  - Pulmonary edema, enlarged kidney
- Also associated with immunosuppression
Diagnostic methods

- Immunodiffusion test
- Electron microscopy
- Immunofluorescence technique
- Neutralization test
- Haemagglutination inhibition test
- ELISA
- Restriction enzyme analysis
- DNA in situ hybridization
- **Polymerase chain reaction (PCR) and sequencing of the Hexon gene**

![Image of virus particles and a close-up view of a viral structure]
Phylogenetic analysis of the Hexon gene

FAV serotypes prevalent in India

- Serotype-4
- Serotype-8
- Serotype-11
- Serotype-2?
VRDC, Serotype-11, Group D
Reproduction of the disease
Prevention and Control

Eradication

• Not possible, as widespread distribution of adenoviruses throughout the world.

• Some strains move between domestic and wild birds

Vaccines

• Developed after the outbreaks of IBH and HPS, with inactivated liver suspension with adjuvant.
Magic Bullet

- Scientific concept developed by a German Nobel laureate Paul Ehrlich in 1900

- An idea that it could be possible to kill specific microbes that cause diseases without harming the body itself.

- By further research, he realised that antibodies sometimes failed to kill microbes.

- Abandoned his first idea on magic bullet.
Vaccination of Breeders

• Australia and the US for **FAdV8**

• Asia (including India) and South America for **FAV-4**

• Canada and Europe: Autogenous vaccines, also followed in different parts of the world.

Cross Protection

• Primarily serotype specific, Birds can shed a serotype while having antibodies to another serotype

• Between **Serotypes 3 & 4** belonging to Species C

• Between **Serotype 2 & 11** belonging to Species D

Progeny Protection

• Level of maternal antibodies, depends on vaccine and application schedule (single, twice)

• Serotypes challenged
Ubiquitous with wide array manifestations as “Primary Pathogen”

Adenoviruses are involved in the “Disease Complexes”

“Vertical transmission”

Endemic strains vary by Region and Company

New strains may be introduced by “Spiking males”

FAV “Serotype 4, 8 and 11” are prevalent in India.

“Vaccination”: Decrease virus shedding.
Thanks