Infectious bronchitis virus, transmission

J.J. (Sjaak) de Wit, DVM, PhD, dipl ECPVS
Infectious bronchitis virus

Corona Virus, a ssRNA virus

- Relatively high rate of mutations (0.0012 subst per nt per jaar)
- Also recombinations

Many serotypes/genotypes:
- Massachusetts (M41, H120), D274, D1466, Ark, Conn, Delaware, Florida, California, GA98, 793B (4/91, CR88), D388 (QX), B1648/D8880, Q1, T-strain, TW1, etc, etc

sensitive to detergents (fat) and disinfection (proteins)

Take care of faeces!
IBV, very infectious, fast spreading

466  J. J. de Wit et al.

**Figure 1.** Average titre (log$_{10}$ EID$_{50}$ per 0.2 ml swab medium) of virus excreted by IBV-infected chickens in unvaccinated group C1.

**Figure 2.** Average titre (log$_{10}$ EID$_{50}$ per 0.2 ml swab medium) of virus excreted by IBV-infected chickens in unvaccinated group C2.
Transmission parameter $R_h$

Average number of birds that’s infected by one infected

$R_h < 1$

$R_h > 1$
IBV, very infectious, fast spreading within a group

- Transmission parameter $R$
  - Average number of birds that’s infected by one infected bird.
  - De Wit et al, 1998, Avian Pathology, 27, 464-471
    - $R_0$ M41: 19.95
    - $R$ M41 in H120 vaccinated group: 0.69
  - Matthijs et al, 2008, Avian Diseases, 461-466
    - H120: $R$ 3.7 (2.1-∞)
    - M41: very high
Spreading

- Between birds of same house
- Between houses in neighbourhood
- Between farms
- Between regions/countries

- Different mechanisms?
Spreading

• Vertically
  – can not be excluded but seems to be hardly relevant
    • IBV can be in egg (e.g. by infected semen, by infection of hens)
    • Can be detected in the egg and some DOC
    • DOC did not replicate the IBV (Cook et al 1967, Cook 1971)

• Horizontally
  – By far the most important way, sources of IBV:
    • Infected chickens
    • Non-chickens??
Role of wild birds

- Mechanical spreading of infected material

- Source of (new?) IBV strains, unknown reservoir??
IBV-like strains in non-chickens

- Pheasant:
  - IBV-like virus, genetically not very different
  - Respiratory signs, nephritis
  - In chicken: no disease, some ciliostasis, seroconversion
  - IBV in pheasant: no infection

- Many IBV-like viruses in other species, however, unknown whether they are a danger for chickens

- Might be the source when a completely new genotype appears (D1466, DE072, ….)

Wild birds, Muradrasoli et al, 2010
Threats of transport infected poultry

• Spreading of infected birds

• Excretion of infected (fecal, airborne) content during transport
Back yard

• Main threat by infected birds:
  – At home
  – Placing new birds
  – Bird to birds or birds faeces contact in the village
  – Disposal of dead birds
  – Transporting birds
  – Cock fights
Horizontal spreading, outside the chicken

- Excretion of IBV
  - Respiratory tract: in mucus, droplets
  - Cloaca (intestines, kidney, oviduct): faeces
  - Eggs
Depending on wind, T, sun light. Humidity, amount of excretion, number of susceptible birds, required dose of virus to infect birds etc
Threats of faeces

- Transportation of infected manure.
- Piling manure close to a farm.
- Use of infected manure as fertilizer.
- Infected dust (faeces) and airborne transmission: farm density or presence of poultry industry and multiple age farms
Threats of vehicles

• Infected trucks on/close to the farm.
  – Wheel arches, bottom and the loading area.
  – Load itself.
  – Driver

• Farm location along the main road.
Threats of rodents, insects

- Passive vector
  - Remain on the farm after cleaning
  - Contacts between farms/houses
Fomites

- Feed
- Litter
  - Wild birds?
  - Infected manure
- Equipment
  - Vaccination/debeaking equipment
  - Crates
  - Egg containers/trays
- Transport media/vehicles
Humans, cats, dogs

- Passive transporter
  - Contact with other farms or poultry industry (second job)
  - Poultry or pet birds at home
  - Attending cock fights
  - In houses and outside
Against transmission

- Biosecurity, management (feces, fomites, people)
- Vaccination: less susceptible, less excretion
Make birds less susceptible

- Vaccination
- Protection against mortality
- Protection against disease
- Protection against seroconversion/viremia
- Decrease of excretion!
- Protection against transmission bird to bird
- Protection against transmission flock to flock
- Protection against transmission farm to farm
Protection

- A meta-analysis
- 18 IBV vaccination-challenge experiments
- 137 groups, 10 clusters
- Vaccines of 6 serotypes, live and inactivated
- 8 challenge viruses (serotypes)
<table>
<thead>
<tr>
<th>Cluster</th>
<th>Type of group</th>
<th>Number of groups</th>
<th>Number of birds</th>
<th>Serotype of vaccines applied</th>
<th>Serotype of challenge virus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative control</td>
<td>Negative controls (no vaccination, no challenge)</td>
<td>26</td>
<td>190</td>
<td>Mass, 793B, D274, D1466, Ark</td>
<td>None</td>
</tr>
<tr>
<td>Positive control</td>
<td>Positive controls (no vaccination, challenged)</td>
<td>23</td>
<td>204</td>
<td>None</td>
<td>Mass, D388, D1466, Q1, D274, GA98, 793B</td>
</tr>
<tr>
<td>YoungHorn</td>
<td>Homologous challenge after live vaccination (single, combination or as second) of young chickens (non-D1466 vaccines)</td>
<td>18</td>
<td>173</td>
<td>Mass, D274, 793B</td>
<td>Mass, D274, 793B</td>
</tr>
<tr>
<td>YoungD1466</td>
<td>Homologous D1466 challenge after live D1466 vaccination (single, combination or as second) of young birds</td>
<td>12</td>
<td>127</td>
<td>D1466</td>
<td>D1466</td>
</tr>
<tr>
<td>Field</td>
<td>Homologous challenge after live vaccination in the field of young chickens</td>
<td>5</td>
<td>48</td>
<td>Mass, D274</td>
<td>Mass</td>
</tr>
<tr>
<td>YoungHetSingle</td>
<td>Heterologous challenge after one live vaccination of young birds</td>
<td>12</td>
<td>119</td>
<td>Mass, 793B, D1466, QX</td>
<td>Mass, D1466, Q1, GA98, 793B</td>
</tr>
<tr>
<td>YoungHetMulti</td>
<td>Heterologous challenge after one or two vaccinations with two or three different serotypes of young birds</td>
<td>22</td>
<td>211</td>
<td>Mass, 793B, D274, Ark, QX</td>
<td>Mass, D1466, D388, Q1, GA98, 793B</td>
</tr>
<tr>
<td>LayHomInac</td>
<td>Homologous challenge of adult layers after use of live and inactivated vaccines</td>
<td>6</td>
<td>60</td>
<td>Mass, 793B, D274, D1466</td>
<td>Mass, 793B, D1466, D388, IT402</td>
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<td>60</td>
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<td>Mass, 793B, D1466, D388, IT402</td>
</tr>
<tr>
<td>LayHetLive</td>
<td>Heterologous challenge of adult layers after use of only live vaccines</td>
<td>7</td>
<td>50</td>
<td>Mass, 793B, D274</td>
<td>Mass, 793B, D1466, D388, IT402</td>
</tr>
</tbody>
</table>
Overview of mean TOC score per category of 137 groups of chickens in 18 vaccination/challenge experiments (De Wit et al, Avian Pathology, 2013)

<table>
<thead>
<tr>
<th>cluster</th>
<th>vaccines</th>
<th>Mean ciliostasis protection score (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>young</td>
<td>No (neg. control)</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>No (pos. control)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Homologous (excl D1466)</td>
<td>97</td>
</tr>
<tr>
<td></td>
<td>D1466</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Homologous, field applied</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Heterologous single</td>
<td>53 (15-92)</td>
</tr>
<tr>
<td></td>
<td>Heterologous ≥ 2 strains</td>
<td>75 (40-100)</td>
</tr>
<tr>
<td>In lay</td>
<td>Homologous, with an inact.</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>Heterologous, including inact.</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>Heterologous, only live</td>
<td>44</td>
</tr>
</tbody>
</table>
Reduction of shedding by proper vaccination program

- Titar-Kis *et al.*, Rhh 2012, pp194-203
  - Mass (D0)+793B(D11)
  - Reduction in virus shedding post challenge (heterologous)
    - J2: 12,589x
    - Var 2: 6310x
    - D1456/EG: 7943x
Increase of required dose to infect post vaccination

- Challenge dose in experiments: $10^3$-$10^4\text{ EID}_{50}$ (young birds) $10^4$-$10^6\text{ EID}_{50}$ (old birds)
  - Sufficient for non-vaccinated birds
  - Not sufficient for many well vaccinated birds

- Well vaccinated birds need a lot more virus before they get infected
  - Lack of data
Increasing number of countries have to deal with an increasing number of variants

Some variants stay for a longer time, others come and go (and may reappear)

In many countries, broad protection is needed
Broad protection by combinations of live IBV vaccines

• Day 0 and 14
  – Hatchery reliability for the first vaccine
  – Reliability application in het field?
  – No/far less influence of maternally derived antibodies anymore
  – Immunesystem is more mature at 14 days
  – No interference between IBV vaccines (when of different protectotype)

• Combined at day 0
  – Hatchery reliability for both vaccines
  – More influence of maternally derived antibodies
  – Potential interference between IBV vaccines (lower efficacy?)
Use of inactivated vaccines

- highly recommended for areas with challenge
Thank you for your attention