Infectious Bronchitis: how to maximize cross-protection

SJAAK DE WIT

GD Animal Health - The Netherlands
Infectious Bronchitis: how to maximize cross-protection

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

GD Animal Health
Deventer
the Netherlands
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!
Infectious bronchitis virus

- Many serotypes:
  - Massachusetts (M41, H120), D274, D1466, D3128, Ark, Conn, Delaware, Florida, California, Holte, 793B (4/91, CR88), D388 (QX), B1648/D8880, Gray, T-strain, etc, etc
  - Genetic variants Argentina, Brazil, Chili

- 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 reappear)

- In general: broad protection needed
Western Europe

A reverse transcriptase-polymerase chain reaction survey of infectious bronchitis virus genotypes in Western Europe from 2002 to 2006

K. J. Worthington,* R. J. W. Currie† and R. C. Jones†

†Department of Veterinary Pathology, University of Liverpool, Leahurst, Neston, South Wirral CH64 7TE, UK, and †Fort Dodge Animal Health, Hanstietenweg 177, 1441 GM Naarden, The Netherlands

Table 3. Numbers of IBV genotypes detected in the countries of Western Europe by RT-PCR between 2002 and 2006.

<table>
<thead>
<tr>
<th></th>
<th>United Kingdom</th>
<th>France</th>
<th>Germany</th>
<th>Holland</th>
<th>Belgium</th>
<th>Spain</th>
<th>Western Europe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number tested</td>
<td>1580</td>
<td>896</td>
<td>655</td>
<td>564</td>
<td>259</td>
<td>149</td>
<td>4103</td>
</tr>
<tr>
<td>Number IBV-positive</td>
<td>1024</td>
<td>460</td>
<td>345</td>
<td>347</td>
<td>158</td>
<td>85</td>
<td>2419</td>
</tr>
<tr>
<td>% IBV-positive</td>
<td>64.8</td>
<td>51.3</td>
<td>52.7</td>
<td>61.5</td>
<td>61.0</td>
<td>57.0</td>
<td>59.0</td>
</tr>
<tr>
<td>Proportion of each infectious bronchitis genotype (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>793B</td>
<td>12.4</td>
<td>53.7</td>
<td>27.5</td>
<td>26.5</td>
<td>18.4</td>
<td>25.9</td>
<td>33.8</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>22.6</td>
<td>22.8</td>
<td>29.0</td>
<td>27.2</td>
<td>20.3</td>
<td>21.2</td>
<td>24.1</td>
</tr>
<tr>
<td>Italy02</td>
<td>19.8</td>
<td>6.7</td>
<td>1.4</td>
<td>6.3</td>
<td>1.9</td>
<td>48.2</td>
<td>12.6</td>
</tr>
<tr>
<td>QX-like</td>
<td>0</td>
<td>12.0</td>
<td>23.8</td>
<td>20.2</td>
<td>22.8</td>
<td>0</td>
<td>10.0</td>
</tr>
<tr>
<td>D274</td>
<td>7.0</td>
<td>1.1</td>
<td>11.9</td>
<td>12.4</td>
<td>25.3</td>
<td>4.7</td>
<td>8.5</td>
</tr>
<tr>
<td>Arkansas</td>
<td>12.8</td>
<td>0</td>
<td>0</td>
<td>1.7</td>
<td>5.1</td>
<td>0</td>
<td>6.0</td>
</tr>
<tr>
<td>B1648</td>
<td>0</td>
<td>1.3</td>
<td>0.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
</tr>
<tr>
<td>D1466a</td>
<td>1.4</td>
<td>0.9</td>
<td>3.5</td>
<td>4.3</td>
<td>4.4</td>
<td>0</td>
<td>2.3</td>
</tr>
<tr>
<td>Otherb</td>
<td>4.1</td>
<td>1.5</td>
<td>2.6</td>
<td>0.9</td>
<td>1.9</td>
<td>0</td>
<td>2.5</td>
</tr>
</tbody>
</table>

The predominant genotype in each country is underlined. *Results available only since 2005. †Other refers to samples with more than one genotype, or genotypes with novel sequences with no matches on the database.
Genotypes of infectious bronchitis viruses circulating in the Middle East between 2009 and 2014

Kannan Ganapathy, Christopher Ball, Anne Forrester

Table 2

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Egypt</th>
<th>Jordan</th>
<th>Kuwait</th>
<th>Lebanon</th>
<th>Oman</th>
<th>Saudi Arabia</th>
<th>UAE</th>
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</thead>
<tbody>
<tr>
<td>7938</td>
<td>16.8</td>
<td>0</td>
<td>0</td>
<td>13.8</td>
<td>53.7</td>
<td>42.2</td>
<td>85</td>
</tr>
<tr>
<td>15/1404/06</td>
<td>4.1</td>
<td>100.00</td>
<td>100.00</td>
<td>82.5</td>
<td>27.2</td>
<td>11.0</td>
<td>0</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>8.3</td>
<td>0</td>
<td>0</td>
<td>4.4</td>
<td>3.0</td>
<td>17.4</td>
<td>0.0</td>
</tr>
<tr>
<td>15/18600</td>
<td>70.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>11.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Q1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>17.0</td>
<td>0.0</td>
</tr>
<tr>
<td>0274</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12.1</td>
<td>0.4</td>
<td>11.1</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Fig. 2. Prevalence of different IBV genotypes circulating on Iranian broiler farms during 2014-2015

ANNUAL SEQUENCE RECORD

Emergence of a novel genotype of avian infectious bronchitis virus in Egypt

Ahmed S. Abdel-Moneim, Mamad A. Aref, Magdy F. El-kady
Molecular Characterization and Pathogenicity of Infectious Bronchitis Coronaviruses: Complicated Evolution and Epidemiology in China Caused by Cocirculation of Multiple Types of Infectious Bronchitis Coronaviruses

Shengwu Liu, Xiaoman Zhang, Yu Wang, Chengren Li, Zongdi Han, Yuhao Shao, Helin Li, Xiangjing Kong

Division of Avian Infectious Diseases, National Key Laboratory of Veterinary Biotechnology, Harbin Veterinary Research Institute, Chinese Academy of Agricultural Sciences, Harbin, Heilongjiang, China

AVIAN DISEASES 56:634–641, 2012

REVIEW ARTICLE

Infectious bronchitis virus variants: current situation and control measures

J. J. (Sjaak) de Wit, Jane K. A. Cook and Harold M. J. F. van der Heijden


Sequence analysis of the S1 glycoprotein gene of infectious bronchitis viruses: identification of a novel phylogenetic group in Korea

Ji-Hyun Jang, Haan-Woo Sung, Chang-Seon Song, Hyuk-Moo Kwon

S1 and N Gene Analysis of Avian Infectious Bronchitis Viruses in Taiwan

Yuan-Pin Huang, Hsin-Chun Lee, Ming-Chu Cheng, and Ching-Ho Wang

Department of Veterinary Medicine, National Taiwan University, P.O. Box 25-3, Taipei 10617, Taiwan

Received 30 March 2004; Accepted 10 May 2004

Phylogenetic distribution and predominant genotype of the avian infectious bronchitis virus in China during 2008–2009

Invited Review—

Review of Infectious Bronchitis Virus Around the World

Mark W. Jackwood

JOURNAL OF VETERINARY SCIENCE

N DISEASES 48:581–589, 2004
IBV globally

• Increase of nephropathogenic strains???
  – QX: Europe, Asia, parts of Africa
  – Q1: Latin America, Middle East, Asia, Europe
  – Variant 2 (Israel 1494/06): Middle East
  – BR-I
  – Australia: 3 subgroups

• How many genotypes????
  – Three ‘new’ ones in last 6 months (at GD alone)

• Role of wild birds???
Disease IBV

- depends on:
  - pathotype
  - strain (variation within serotypes)
  - type of chicken
  - age
  - climate: ammonia, dust, *E. coli*, ORT
  - co-infections (viruses, *Mycoplasma*)
  - protection: vaccination, serotype, protectotype
Broad protection by combinations of live IBV vaccines

• **Day 0 and 14**
  – Hatchery reliability for the first vaccine
  – Reliability application in the field?
  – No/far less influence of maternally derived antibodies anymore
  – Immune system 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
• A meta-analyses
• 18 IBV vaccination-challenge experiments
• 137 groups, 10 clusters
• Vaccines of 6 serotypes, live and inactivated
• 8 challenge viruses (serotypes)
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>
Aim of the study

- to determine the level of protection against a challenge with IBV D388/QX at day 28 or with IBV Q1 at day 29 (eye drop, $10^4$ EID$_{50}$ per bird)
  - Ciliostasis test: 5 TOCs per chicken, level of beating of the cilia in each ring (TOC score) was expressed as 4 (< 25% beating of cilia), 3 (25 to 50% beating), 2 (50 to 75% beating), 1 (75 to 99% beating) or 0 (all beating). One chicken could score between 0 and 20 (five rings from each trachea; maximum score 4).
  - CPS = 100% – {100 x total of the individual scores} / { number of individuals x 20}
- both commercial broilers and SPF layers in isolators
- All groups vaccinated at day 1 with:
  - Mass A + IB88 (793B - A),
  - Mass B + 793B - B
  - Mass + D274
  - Mass C + 793B - C
Broilers: protection % against QX 5 dpc

Percentage of ciliary protection

- Mass A + IB88 - A
- Mass B + 793B - B
- Mass C + 793B - C
- Mass D + D274
- Positive K.
- Negative K.
Broilers: protection % against Q1 5 dpc

SPF: protection % against QX 5 dpc
SPF: protection against Q1 5 dpc
The results of all control groups were valid.

SPF: all vaccination programs using eye-drop were able to induce high levels of cross-protection in the SPF birds against the D388 and Q1 challenges at 4 weeks of age.
- the level of cross-protection against the D388 (QX) challenge varied from 96% up to 100%,
- the level of cross-protection against Q1 varied from 91% to 100%.

Commercial broilers: all vaccination programs using eye-drop were also able to induce a significant level of cross-protection in the commercial broilers with maternally derived antibodies against the D388 and Q1 challenges at 4 weeks of age.
- the level of cross-protection against the D388 (QX) challenge varied from 70% up to 94%,
- the level of cross-protection against Q1 varied from 87% to 97%.
Conclusion

- The combination of **Mass A with IB88** at day of hatch induced high levels of protection against both IBV **D388** and **Q1** in SPF layers and commercial broilers.

- These results indicate that combined administration of both vaccines at one-day of age does not negatively affect the efficacy of the individual vaccines against a challenge with IBV D388 and IBV Q1.
Thank you for your attention
MERIAL GLOBAL AVIAN FORUM

INNOVATION IN AVIAN DISEASE CONTROL STRATEGIES AND VACCINE ADMINISTRATION

BARCELONA - SPAIN

APRIL 26TH 27TH 28TH 2016