Interaction of Gumboro and other Immunosuppressive Diseases on Respiratory Disease

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Broilers: Intestinal Virus Detection by Age

- Astrovirus
- Rotavirus
- Reovirus

N=258 Cases

Age - Days

No. Cases

Broilers: Cases by Enteric Viruses Detected

- Astrovirus
- Rotavirus
- Reovirus
- AstroRota
- AstroReo
- RotaReo
- AstroRotaReo

N=258 Cases
Viral Enteritis in Broilers
Bursa and Thymus Atrophy

Virus Positive Broilers <20 days:
Maximum Bursa Depletion Score

Virus Positive Broilers <20 days:
Maximum Thymus Depletion Score
Marek’s Disease
Immunosuppression

- Occurs at a young age
- Difficult to confirm
- Assume - if problems exist in Marek’s tumors or clinical disease
Acute Marek’s Disease and Immunosuppression

Acute Marek’s disease infection causes necrosis and depletion of the bursa of Fabricius, thymus, and cecal tonsils

Cecal Tonsil:


Impact: Permissive environment for respiratory virus persistence and shed: Bronchitis and Newcastle
Infectious Bursal Disease – Classical
Variant Bursal Disease Virus

- No breeder vaccination
- Breeder vaccination
- Unchallenged control
Bursa
Acute Bursitis (Acute Gumboro)

Normal

Necrosis (acute)
Acute Bursal Disease: Necrosis

The bird is susceptible to IBD at this age
- Maternal antibody diminished, or
- Variant challenge virus attacks through existing immunity, or
- Massive challenge virus overwhelms existing immunity

Bursa contains abundant virus

Good for virus isolation or detection by PCR

Acute bursal disease marks the onset of transient or possible permanent immunosuppression.
Post-necrotizing Bursitis
Follicular Repopulation/Restitution

Grade 2

Grade 2.5 Large Follicle

Grade 3

Grade 3.5

Grade 4
## Bursa Grading: Broiler Case Study
### Early Bursal Disease Challenge

<table>
<thead>
<tr>
<th>Flock</th>
<th>14</th>
<th>21</th>
<th>25</th>
<th>28</th>
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<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3.5</td>
</tr>
<tr>
<td>B</td>
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<td>N</td>
<td>3.5</td>
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<tr>
<td>J</td>
<td>N</td>
<td>3.5</td>
<td>4</td>
<td>3.5</td>
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</table>

**Legend:**
- 1 = Normal
- 2 = Mild Depletion
- 3 = Moderate
- 3.5 - 4 = Necrosis/Marked ~ Severe
Chicken Infectious Anemia

Thymus
Grade 4 Lymphocyte depletion (CAV)
Bursa and Thymus: First 14 Days
Primary Lymphoid Organs Seed Secondary Organs
Diagnostic Laboratory Perspective

Atrophy of the bursa and thymus are routinely observed in broiler chickens submitted to diagnostic laboratory

Principle diagnoses
- Infectious bronchitis, vaccine strains isolated
- Coccidiosis, especially *Eimeria maxima*
- Gangrenous dermatitis

Bursal atrophy is primarily associated with infectious bursal disease

Thymus atrophy is primarily associated with chicken infectious anemia (PCR positive)
- Also possible Marek’s
1993: CAV Infection & Thymus Atrophy after Depleted Maternal Immunity

No anemia observed

Lymphocyte and macrophage suppression

- T-cell growth factor, interferon, and transformation
- Macrophage FC receptor expression, interleukin-1, phagocytosis and bactericidal activity

Immunosuppression Markers in Field Cases: Bursa and Thymus Histopathology Scores

Bursa

Thymus

1

2

3

4
Summary of 6-year Study

CAV infection was widespread

Thymus atrophy associated with CAV infection

CAV, thymus atrophy, and bursa atrophy were more prevalent in chickens with clinical disease

- Respiratory
- Gangrenous Dermatitis
- Coccidiosis

Laboratory findings correlated with economic losses.

Alabama Broilers

Lymphocytic Depletion by Age of Submission (N=631)

Mean Depletion Score

Age at Submission to Laboratory (Days)

- Bursa
- Thymus
Thymus and Bursa Lymphocyte Depletion

Bursa Lymphocyte Depletion by Maximum Thymus Depletion

<table>
<thead>
<tr>
<th></th>
<th>Thymus 1</th>
<th>Thymus 2</th>
<th>Thymus 3</th>
<th>Thymus 4</th>
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<tbody>
<tr>
<td>Mean Bursa Lymphocyte Depletion</td>
<td><img src="image-url" alt="Graph" /></td>
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</table>

Kruskal-Wallis
P<0.0001

Maximum Thymus Lymphocyte Depletion

- Thymus 1: a
- Thymus 2: a, b
- Thymus 3: b, c
- Thymus 4: c
Alabama Broilers

Lymphocytic Depletion by Age of Submission (N=631)

Mean Depletion Score

Age at Submission to Laboratory Days

Bursa
Thymus
IBV Isolates

Mean Depletion Score

IBV Isolates

Mean Depletion Score

IBV Isolates

Mean Depletion Score

IBV Isolates
Alabama Broilers and Broiler Sentinels
IBV Isolations
Clinical Signs: Tracheal Rales

Toro, et al. 2006 Avian Pathology 35:455-64
Anti-IBV IgA in Tears: ELISA

Toro, et al. 2006 Avian Pathology 35:455-64
## Infectious Bronchitis Tears: RT-PCR Ark Field Strain

<table>
<thead>
<tr>
<th>Individual samples</th>
<th>IBV</th>
<th>CAV + IBDV + IBV</th>
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</thead>
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<tr>
<td>11 dpi</td>
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<tr>
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<tr>
<td>24 dpi</td>
<td><strong>Not done</strong></td>
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<tr>
<td>28 dpi</td>
<td><strong>Not done</strong></td>
<td><img src="bandcaidbidvibv28dpi" alt="IBV band" /></td>
</tr>
</tbody>
</table>

Toro, et al. 2006 Avian Pathology 35:455-64
Interaction of Infectious Bronchitis Virus, Infectious Bursal Dis., and Chicken Infectious Anemia: Harderian Gland IBV-specific IgA response


Gumboro and CAV, alone and in combination, reduce the number of IBV-specific IgA lymphocytes in the Harderian Gland
Gumboro and CAV infection influence the selection of IBV vaccine subpopulations

<table>
<thead>
<tr>
<th>Group</th>
<th>Experiment 1</th>
<th>Experiment 2</th>
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</thead>
<tbody>
<tr>
<td>Immunocompetent</td>
<td>$C_1^a &gt; C_4 &gt; C_5$</td>
<td>$C_4 &gt; C_1$</td>
</tr>
<tr>
<td>IBDV</td>
<td>$C_1 = C_4 = C_2 &gt; C_5$</td>
<td>$C_4 &gt; C_2 &gt; C_1$</td>
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<tr>
<td>CAV</td>
<td>$C_1 = C_4 &gt; C_2 = C_5$</td>
<td>$C_4 &gt; C_1 &gt; C_2$</td>
</tr>
<tr>
<td>CAV + IBDV</td>
<td>$C_4 &gt; C_5 &gt; C_1 = V_x^b$</td>
<td>$C_4 = C_1 &gt; C_5 &gt; C_3 = C_2$</td>
</tr>
</tbody>
</table>

$^a$Selected subpopulations, designated $C_1$ to $C_5$. $^b$Vaccine major population.

Immunosuppression could change the anticipated performance of an infectious bronchitis vaccine through permissive replication of virus subpopulations.

Working model: Subpopulations at-risk

- Ammonia, Stress
- Marek’s
- Viral Enteritis
- CAV

- Ammonia, Stress
- Viral Enteritis
- CAV
- Marek’s
Immunosuppression – Erosion of Health and Productivity

A variable percentage of the flock is affected

Goal – Minimize the number of birds in the subpopulation
Recommendations

Conduct mortality surveys paying attention to bursa and thymus

Histopathology surveys to assess bursa and thymus health
  ◦ Evidence of viral enteritis at 10-14 days

Monitor the bursal disease vaccination program
  ◦ Necropsy, histopathology, and define challenge strains

Monitor thymus for atrophy
  ◦ CAV
  ◦ Marek’s disease

Virus isolation/Molecular detection, and serology to understand respiratory challenge
  ◦ Typing of challenge viruses to define epidemiology
Thank You

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