Infectious Bursal Disease, Immunosuppression and the role of VAXXITEK® HVT+ IBD

Grogan K.1


Abstract

Immunosuppression costs the poultry industry exponential sums in increased mortality, performance figures, and condemnations at processing. Control of immunosuppression in broilers is primarily based on vaccination programs for breeders and broiler progeny, along with management to minimize stress. This paper looks at infectious bursal disease virus (IBDV) as an immunosuppressive agent and how the broiler responds to infection. Histologic scoring methods were used to evaluate the recovery of the bursa following natural field infections in broilers vaccinated with VAXXITEK HVT+IBD or conventional broilers.

Introduction

Acute infectious bursal disease (IBD) infection may occur as clinical or subclinical disease, and mortality is a feature of very virulent strains of IBDV. The immunosuppression that follows clinical infection with IBDV is variable depending on bird age at time of infection, with the most pronounced effects seen when infection occurs between hatch and 2-3 weeks of age [1]. At this time point, subclinical infections occur, depending on the virus strain, showing no clinical signs but severe bursal damage. Immunosuppression will occur following clinical IBDV infections at any age. Bursal atrophy can be seen in affected birds as early as 3-4 days post infection with very virulent (vv) IBDV, but with other IBDV infections, atrophy normally begins at day 8 post-infection. The atrophy persists for approximately 12 weeks while the bursa is being repopulated by lymphoid cells [1]. The effects of IBD are not only limited to B lymphocytes and the bursa, thymic atrophy occurs during acute infections; however, it is short-lived, returning to a normal state within a few days following infection. When IBD occurs in chickens 14 days of age or younger, B lymphocyte seeding of secondary lymphoid centers is curtailed, resulting in a permanently defective humoral immunity, and leaving the chicken susceptible to secondary infections. In chickens older than 14 days, IBD

1 VAXXITEK is a registered trademark of Merial in the United States of America and elsewhere.
causes transient depression of systemic antibody production and, with necrosis of plasma cells in the Harderian gland, diminished mucosal immunity. Cell-mediated immunity and heterophil and macrophage functions are also transiently depressed [2].

Chickens that survive the acute infection clear the viral infection, and bursal follicles are repopulated, a process that is decreased with more virulent IBDV strains [3]. For individual follicles, two types of recovery are observed histologically following IBDV infection: large reconstituted follicles with numerous lymphocytes in the cortex and medulla, and small poorly developed follicles with a poorly discernible cortex and medulla (Figure 1). Chickens with mostly undifferentiated follicles have reduced ability to mount an antibody response, indicating that B cells in these follicles are unable to produce peripheral B cells containing enough variety and quantity of antibodies [2].

IBD today still occurs in broilers, young breeders, and commercial layer pullet replacements, but the window of susceptibility is about 20 to 30 days of age [2] (Figure 2). The vaccination strategy to deal with the immunosuppression caused by IBDV is two-fold – use of vaccination in breeder flocks and young chickens. IBDV is neutralized by maternal antibodies of the same serotype – reasoning the common practice of hyperimmunizing breeder hens for the common types of IBD present in the field. In order to increase maternal antibody production, hens are vaccinated with live IBD vaccines followed by two or more inactivated vaccines. Along the same concept, the maternal antibodies will neutralize any live vaccines also given to the chicks. The timing of live vaccination is critical in order to administer when passive antibodies are dropping or use a live IBD vaccine that will induce immunity in the face of maternal antibodies. Live IBD vaccines can be administered in ovo, at hatch or in the field through the water or spray.

Material & methods

VAXXITEK HVT+IBD is a HVT vector vaccine expressing the IBDV VP2 gene. Its efficacy has been demonstrated against different strains of IBDV, including classical, very virulent and American variant IBDV strains. The vaccine is also efficacious for Marek’s protection, making it two-fold protection. It can be administered either in ovo (3 days before hatching) or by the subcutaneous route in 1-day old chicks, in the presence of high titers of maternal antibodies.

Bursal tissues were collected at various ages from USA field trials comparing VAXXITEK HVT+IBD vaccinated broilers versus control, conventional broilers (Figure 3). Week per week records of all submitted samples of bursa for histopathology from 2010 and of different origins, USA, and the rest of the American continent, were compiled on one graph (Figure 4). The tissues were formalin fixed and stained in hematoxylin and eosin. Bursas were scored using the scoring system in Figure 2.
Results / Discussion

The bursas from birds vaccinated with VAXXITEK HVT+IBD displayed increased bursal repopulation from day 21 on resulting in a lower bursal score. All trials had comparable results; with VAXXITEK HVT+IBD vaccinated groups showing lower bursal scores in all groups at 25 and 28 days (Figure 3).

Conclusion

Vaccination with VAXXITEK HVT+IBD protected the bursa from the damaging effects of IBDV infection. Bursas recovered more effectively as evidenced by the lower histologic scores obtained in the VAXXITEK HVT+IBD groups. Birds vaccinated with VAXXITEK HVT+IBD displayed a higher population of large follicles in the bursa, which correlates with partial recovery of antibody response.

References

**Figure 1**: Post-IBD follicular restoration, small versus large follicles.

*Small follicles: lymphocyte restoration from medullary stem cells, with minimal or no immune response capability. **Large follicles: rapid proliferation of B cells correlated with partial recovery of antibody response.

**Figure 2**: Bursal scoring histologically as it relates to the pathogenesis of IBDV.

**Bursal Scores: Pathogenesis**

<table>
<thead>
<tr>
<th>Bursa Score</th>
<th>Age in Days</th>
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<tbody>
<tr>
<td>1</td>
<td>7</td>
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<tr>
<td>2</td>
<td>14</td>
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<td>4</td>
<td>42</td>
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<td>5</td>
<td>56</td>
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- **Protected**
- **Acute Bursitis**
- **Post-active Recovery Phase**

Bursa recovery: "restitution, repopulation"
Figure 3: Average bursa histologic scores from USA broiler samples.

Green: VAXXITEK HVT+IBD vaccinates; red: conventional live IBD vaccine vaccinates.

Figure 4: Average bursa histologic scores by weeks of age, all 2010 submissions, US and non-US.

Green: VAXXITEK HVT+IBD vaccinates; red: conventional live IBD vaccine vaccinates.