Clostridial Vaccination Efficacy on Stimulating and Maintaining an Immune Response in Preweaned Beef Calves

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Story in Brief

The objective of this experiment was to determine the efficacy in stimulating and maintaining an immune response in the presence of maternal antibodies and compare the extent of the responses to revaccination. One hundred eighteen nursing calves were randomly assigned to receive Alpha-7® (A7) or Ultrabac® 7 (UB7) at 50.4 days of age (day 0 = date of birth). Calves were revaccinated with the same treatment on day 170. Blood samples were collected from 10 calves of each treatment group on day 50, 170 (before revaccination), and on day 191 to determine antibody titers for overeating disease (Cl. perfringens type C), pulpy kidney (Cl. perfringens type D), and blackleg (Cl. chauvoei). The A7 treated calves tended to have higher antibody titers for overeating disease on day 170. The rate of change in pulpy kidney antibody titers from day 170 to day 191 tended to be higher for the UB7 treated calves compared with the A7 treated calves. There was also a tendency for enhanced blackleg antibody titers on day 191 for the A7 treated calves than for the UB7 treated calves.

Introduction

Clostridial diseases are a concern of cattle producers. Because clostridial diseases are often rapidly fatal and usually affect cattle six months to two years of age, most producers view vaccination as cheap insurance. Many clostridial vaccines require revaccination four to six weeks following the initial treatment (Compendium of Beef Products, 1993), but many cow/calf producers fail to revaccinate their calves at that time.

The objective of this experiment was to compare the effectiveness of a single injection of a 2-ml (Alpha-7®) vaccine with a single injection of a 5-ml (Ultrabac® 7) vaccine in stimulating and maintaining an immune response in the presence of maternal antibodies.

Experimental Procedures

Nursing crossbred beef calves (n = 118, from multiparous beef cows) born in February and March were used. At the time of treatment, the average calf age was 50.4 ± 15.30 days (mean ± standard deviation). All calves were individually identified and randomly assigned to receive Alpha-7® (A7) or Ultrabac® 7 (UB7). Alpha-7® (Boehringer-Ingelheim) bacteria-toxoid uses an oil adjuvant and is labeled for a single 2-ml injection. Ultrabac® 7 (SmithKline Beecham) is labeled for a 5-ml injection with revaccination in four to six weeks and uses an aluminum hydroxide adjuvant. Calves assigned to UB7 were not revaccinated four to six weeks following day 50. Revaccination was not completed because many cow/calf producers fail to revaccinate their calves according to label directions. This revaccination treatment schedule was conducted under veterinarian supervision. Both products protect beef cattle against Cl. chauvoei (blackleg), Cl. septicum (malignant edema), Cl. novyi (black disease) and Cl. perfringens types C (overeating disease) and D (pulpy kidney) according to the Compendium of Beef Products (1993). All injections were administered subcutaneously in the neck region using the tented technique. Sixty calves received A7 and 58 calves received UB7. Day 50 was used to designate the time of the initial clostridial treatment (day 0 = date of birth). All calves were revaccinated subcutaneously in the neck region with their assigned treatment on day 170. The dams of these calves do not receive annual clostridial vaccinations. They did, however, receive clostridial vaccinations as preweaning calves.

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Blood was collected via jugular vein puncture from 10 randomly selected calves of each treatment group immediately before each clostridial treatment (day 50 and 170) and on day 191. The same calves from each treatment group were sampled throughout the experimental period. Blood samples were placed in crushed ice immediately after collection. The serum was harvested and stored at -20°C until analyzed. Antitoxin units were determined for overeating disease and pulpy kidney by the antitoxin neutralization test as described by USDA:APHIS:VS (1985 and 1993, respectively), and agglutination titers were determined for blackleg by the serum agglutination test modified from Claus and Macheak (1972).

Calves served as experimental units. The data were analyzed as a complete randomized design. The data were tested for normality by the Shapiro-Wilk test (SAS, 1992). The null hypothesis was rejected (P < .05). Therefore, we concluded that the data were not normally distributed. Data within each time period were ranked, and ANOVA procedures were used to perform the Krushal-Wallis test (SAS, 1994). Ratio between two time periods were determined and ranked for analysis. If data were below detectable levels (1, .1, and 10 for overeating disease, pulpy kidney, and blackleg, respectively), the mid-point between the detectable level and 0 was assigned (.5, .05 and 5 for overeating disease, pulpy kidney, and blackleg, respectively). Because the data were not normally distributed, the variation around each mean value is not reported.

**Results and Discussion**

The average overeating disease antibody titer level was 12.1 on day 50 (probably as a result of maternal antibodies) and was not different across treatments (A7 or UB7, Table 1). The A7 treated calves had a tendency (P < .10) to have higher overeating disease serum antibody titers on day 170 than the UB7-treated calves (1.7 vs. 1.2). There also was a tendency (P < .10) for the change in overeating disease antibody titer levels of the UB7 treated calves from day 170 to day 191 to be greater than the A7 treated calves (1.2 to 7.6 and 1.7 to 4.3). This interaction was partially caused by the lower antibody titer levels of the UB7 treated calves on day 170; however, the overeating disease antibody titer levels on day 191 were not different (P > .10) across treatment groups. Overeating disease causes severe enteritis with diarrhea and dysentery in young lambs, calves, pigs, and foals. Usually calves 7- to 10-days-old are affected by overeating disease, but calves up to 10 weeks of age may also be affected. In very acute cases, death occurs in a few hours, sometimes without diarrhea being evident (Radostits et al., 1994).

Antibody titer levels for pulpy kidney were below detectable levels (< .1) on d 50, and the average antibody titer levels across treatment groups on day 170 were still very low. Pulpy kidney can cause sudden death in calves between one and four months of age. It is a short-term inhabitant that does not usually persist in the soil for more than one year (Radostits et al., 1994). The UB7 treated calves had a greater antibody titer increase (P < .06) from day 170 to day 191 than the A7 treated calves (.03 to 7.20 and .23 to 6.52).

Antibody titers for blackleg were similar for treatment groups on day 50 and day 170. There was a tendency (P < .10) for the A7 treated calves to have higher antibody titers on day 191 as compared to the UB7 treated calves (153.5 vs. 75.8). Blackleg affects growing cattle six months to two-years-old on good nutritional plans. It is a soil-borne infection which causes severe death losses unless cattle are vaccinated (Radostits et al., 1994).

Because calves were not sampled from day 50 to day 170, it is not known if antibody titers increased following the first treatment (day 50) and then decreased, or if maternal antibodies prevented response of the calves’ immune system. Twenty-one days following revaccination (day 191) antibody titer levels for overeating disease and pulpy kidney increased compared with day 170 levels, but this was not the case for antibody titers for blackleg. Kennedy et al. (1977) reported an enhanced response to the second injection for blackleg in yearling calves when the time between injections was four or six weeks. This may suggest that waiting 120 days (over 7 weeks) may be too long for an enhanced blackleg response to the second injection.

**Implications**

Many producers vaccinate suckling beef calves for clostridial diseases with one injection even though many vaccination labels state that two injections should be given. The data implied that vaccinating calves at 50 days of age and not again until weaning may not provide adequate protection against clostridial diseases. With proper management and vaccination timing, calf losses as a result of clostridial diseases may be prevented.

**References**

Table 1. The average antibody titers for overeating disease and pulpy kidney, and antibody titers for blackleg in serum of beef calves.

<table>
<thead>
<tr>
<th>Day of Sampling</th>
<th>Overeating Disease</th>
<th>Pulpy Kidney</th>
<th>Blackleg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A7(^a)</td>
<td>A7</td>
<td>A7</td>
</tr>
<tr>
<td>Day 50</td>
<td>12.1</td>
<td>0(^b)</td>
<td>0</td>
</tr>
<tr>
<td>Day 170 (^e,f)</td>
<td>1.7(^c)</td>
<td>.23</td>
<td>.03</td>
</tr>
<tr>
<td>Day 191</td>
<td>4.3</td>
<td>6.52</td>
<td>7.20</td>
</tr>
</tbody>
</table>

\(^a\) Alpha-7\(^a\) or Ultrabac\(^b\) 7
\(^b\) Below detectable levels (P < .1)
\(^c,d\) Within rows, means not followed by a common superscript differ (P < .10); in the absence of superscripts, means are not different.
\(^e,f\) Means change across sampling period day 170 to day 191 due to treatment effects: e: overeating disease, (P < .10); f: pulpy kidney, (P < .06).