PROFESSIONAL SERVICES
Boehringer Ingelheim Vetmedica, Inc.

TECHNICAL BULLETIN

Immune Response to Express® 5 in Young Calves with Maternal Antibody Before and After a Virulent BVDV Type 2 Challenge

INVESTIGATORS

Ratree Platt[1], Philip W. Widel[2], Lyle D. Kesl[3], James A. Roth[1]
[1]Iowa State University, [2]Boehringer Ingelheim Vetmedica, Inc., [3]Veterinary Resources, Inc.

KEY POINTS

- Calves between 1 and 8 weeks of age with maternal antibody developed B cell memory and CD4, CD8, and gamma delta T cell responses to BVDV types 1 and 2 following vaccination with Express® 5.
- No active antibody response was developed after vaccination.
- Calves were protected against a virulent BVDV type 2 challenge 12 weeks following vaccination
- Calves vaccinated with Express 5 at 4-5 weeks of age responded as well as those vaccinated at 1-2 or 7-8 weeks of age

INTRODUCTION

Diarrhea and respiratory disease are common causes of morbidity and mortality in young calves. In some cases these diseases can be associated with viral infections due to IBR, BVD, BRSV and PI_3. As a result, many producers begin vaccinating young calves with modified live virus vaccines as early as 1-2 weeks of age and periodically revaccinate the calves over the next several weeks. However, the benefit of this practice, and the ability of these young calves to develop a significant active immune response in the face of maternal antibody, has been questioned.

OBJECTIVE

The objective of this study was to evaluate the immune response to Express 5 of various age calves with maternal antibody when Express 5 was administered at different ages (1-2 weeks, 4-5 weeks, and 7-8 weeks) and to evaluate protection against a BVD type 2 challenge.

STUDY DESIGN

A dairy in Iowa was contracted to supply 42 Holstein calves within a few days of birth. The calves were supplied in three groups over a two-month period. All calves received four quarts of pooled colostrum obtained from cows on the dairy. The cows had been previously vaccinated with IBR, BVD, PI_3 and BRSV. Within the first week, calves were confirmed to be negative for BVD persistent infection and confirmed to have SN antibody titers to IBR, BVD types 1 and 2, PI_3 and BRSV. The calves were held in individual hutches until they were 7-8 weeks of age, 4-5 weeks of age, or 1-2 weeks of age. On Day 0, eight calves in each age group were randomly selected and vaccinated with a single, 2 mL, Sub-Q dose of Express® 5 in the neck. The remaining four calves from each group received a 2 mL, Sub-Q dose of sterile saline in the neck.

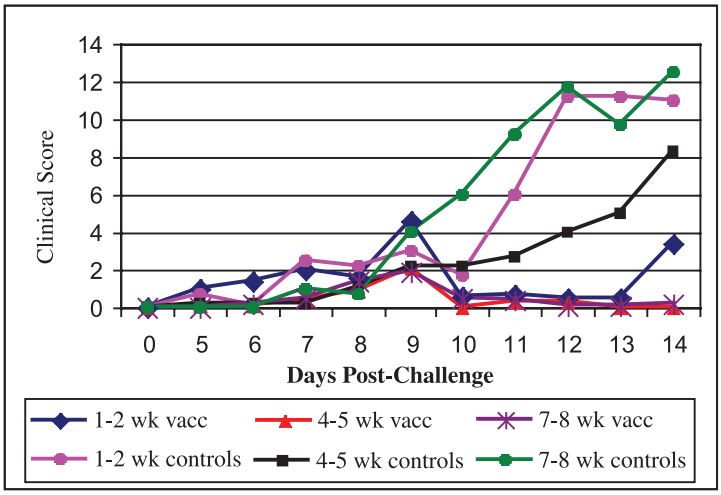
Rectal temperatures were taken on each calf for 14 days following vaccination. Blood was collected on the day of vaccination and periodically throughout a 12-week period prior to challenge. Serum neutralizing (SN) antibody and antigen specific T cell subset responses (expression of CD25, IFNγ and IL-4 by CD4+, CD8+, and gamma delta T cells) were evaluated for IBR, BVD types 1 and 2, PI_3 and BRSV.

At 84 days following vaccination, the calves were challenged intranasally with a virulent BVDV type 2, strain 1373. Following challenge, rectal temperature and clinical scores were recorded, lymphocyte and platelet counts were determined, serum was collected for SN analysis, and whole blood was collected for CMI assays as described above.

RESULTS

All vaccinated calves withstood the virulent BVD type 2 challenge; however, the non-vaccinated calves showed significant clinical signs and lesions due to BVD.

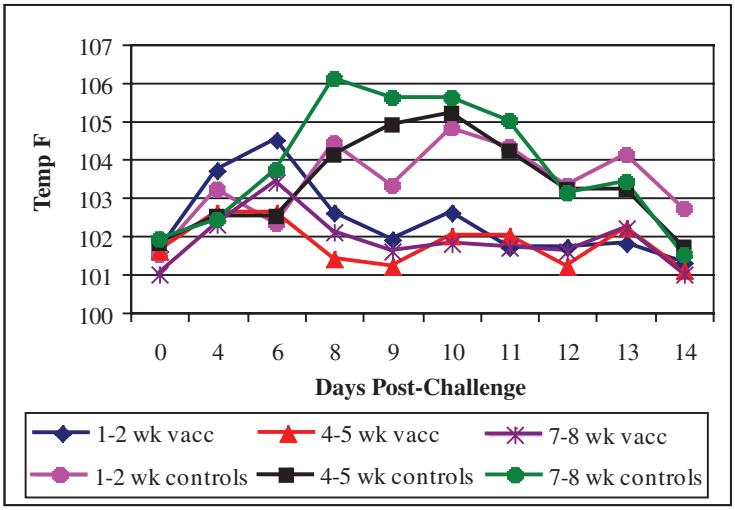
Mean Cumulative Clinical Scores



Following challenge, one non-vaccinated calf in each age group died with BVD symptoms and lesions; however, none of the vaccinated calves died.

Body temperatures post-challenge indicated vaccinated calves were protected from the challenge-induced high fever, with only the 1-2 week vaccinated group having a mean rectal temperature 104.5° F on any day post-challenge. The 4-5 week and 7-8 week control groups each had two or more days with mean temperature above 104.5° F, including the 7-8 week old control group with a mean of 106° F on day 7.

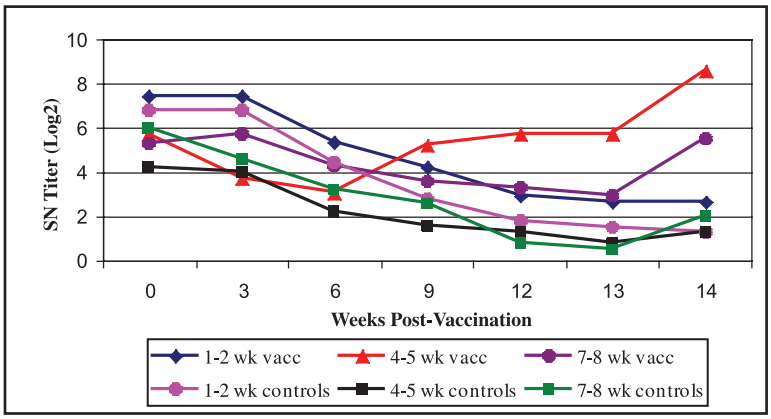
Mean Post-challenge Rectal Temperature



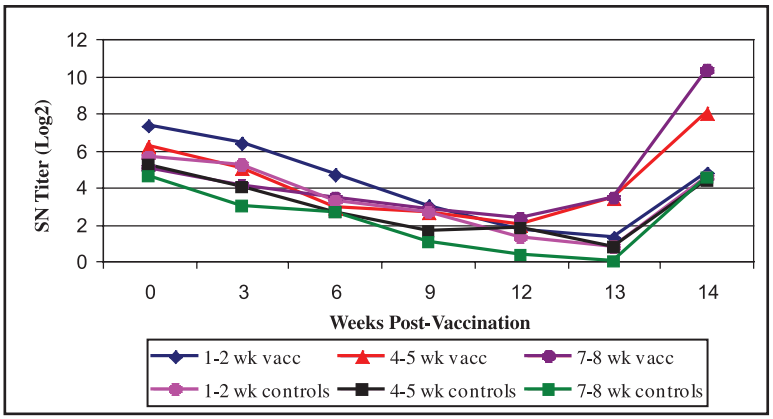
The platelet count of all calves dropped slightly after the BVDV type 2 challenge. After Day 6, platelets in the vaccinated calves began to rise back to pre-challenge levels and the platelets of all the non-vaccinated (control) calves continued to drop dramatically. Following challenge, platelet counts were significantly lower ($p<0.05$) in the non-vaccinates versus the vaccinates on Days 10 and 12 for the 4-5 week and 7-8 week age groups and on Day 14 for the 1-2 week and 7-8 week age groups. The lymphocyte counts showed a similar pattern following challenge. Counts for all calves dropped immediately following challenge; however, after Day 4 the lymphocyte counts in the vaccinated calves of all age groups began to rise back to pre-challenge levels. The lymphocyte counts were significantly higher ($p<0.01$) in vaccinates versus non-vaccinates on Day 6 for the 4-5 week age group and Day 8 for the 4-5 and 7-8 week age groups.

Following vaccination, maternal antibodies declined for all viruses in all groups of calves, except for the BVDV type 1 titer in the calves vaccinated at 4-5 weeks of age. Following the BVDV type 2 challenge, there was an anamnestic response to BVDV types 1 and 2 in the vaccinates of the 4-5 and 7-8 week age groups, but not in the calves vaccinated at 1-2 weeks of age. The type 2 titers were significantly higher ($p<0.05$) in the calves vaccinated at 4-5 and 7-8 weeks versus the calves vaccinated at 1-2 weeks of age.

Mean BVD Type 1 Titers



Mean BVD Type 2 Titers



Cell-mediated immunity (T cell subset recall responses) in response to BVD types 1 and 2 antigens was demonstrated in all three age groups following vaccination. One week following the BVDV type 2 challenge, the vaccinated calves from all age groups continued to have higher T cell responses to BVDV types 1 and 2 versus the non-vaccinated calves.

CONCLUSIONS

- Express® 5, given to 1-8 week old bottle calves with maternal antibody, induced B cell memory and CD4, CD8, and gamma delta T cell responses to BVDV types 1 and 2.
- Twelve weeks following vaccination, all three age groups of calves were protected against a challenge with virulent BVD type 2 virus.
- Calves were protected against a BVDV challenge even though they had maternal antibody against BVDV types 1 and 2 at the time of vaccination.
- The SN titers for both types of BVDV in calves vaccinated at 4-5 and 7-8 weeks of age (but not calves vaccinated at 1-2 weeks of age) had an anamnestic response after challenge.
- Calves vaccinated at 4-5 weeks of age with Express 5 responded as effectively as the other two groups. These results refute the theory that 3-5 week old calves cannot respond to MLV BVD vaccination.
- All three groups of calves developed a T cell response (expression of CD25, IFNγ and IL-4 by CD4+, CD8+, and gamma delta T cells) to BVD types 1 and 2 after vaccination and were protected against BVDV challenge.
- Maternal antibody appeared to have interfered with the T cell subset recall responses and antibody production against IBR, PI_3 and BRSV. Since there was no challenge against any of these viruses it is unknown if the calves would have been protected against challenge.

Boehringer Ingelheim

2621 North Belt Highway • St. Joseph, MO 64506-2002 • www.productionvalues.com

Printed in the U.S.A.