Antibody Response to Inactivated Viral Vaccines Administered to Calves at Weaning

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Summary

Respiratory disease in beef calves has been associated with the stress of weaning. Management practices commonly delay vaccination of calves to this time, and weaning stress could potentially suppress the immune response. To reduce this stress we have been experimenting with a procedure termed "pasture weaning" in which the dams are removed and the calves remain on pasture. Observation suggests that calves weaned with this approach adapt to the weaned state much better than those held in drylot. Consequently, one would expect less stress-mediated effects including those on the immune system.

Calves were weaned and assigned to groups that were pasture or drylot weaned, and calves within the groups were vaccinated with one of two inactivated virus vaccines by either the intramuscular or subcutaneous route. Weaning placement did not affect antibody responses to the viruses included in the vaccines. The route of administration did not influence responses with subcutaneous injection inducing responses equivalent to the intramuscular site. Utilization of this route for vaccination could be advantageous because it precludes the tissue damage and hidden abscessation that sometimes results from intramuscular injections. A distinct difference was noted in the immunogenicity of the vaccines with the Vira Shield product yielding significantly better responses to all viral entities.

Introduction

Respiratory disease is a common occurrence in calves during the period following weaning. Weaned calves are undergoing stress and maternal antibodies have waned contributing to the susceptibility to infectious disease. Immunization can be an effective management practice to reduce the incidence of respiratory disease. However, the choice of vaccine and vaccination protocol are important in ensuring the effectiveness of the immunization process.

Our previous observations indicated that calves weaned on pasture ("pasture weaning") seem to be less stressed than those weaned in drylot. Stress is known to affect the immune system in some situations and to suppress immune responses. Some inactivated virus vaccines have been reported to be more immunogenic than others. The intramuscular route is usually recommended by manufacturers of these vaccines, although the subcutaneous route may be preferable. Therefore, the objective of this experimentation was to determine the effects of weaning approach, vaccine source and route of vaccine administration on the antibody responses of calves.

Materials and Methods

One hundred twelve crossbred calves born in the spring of 1997 were administered a modified live IBR-PI3 virus vaccine intranasally on August 19, 1997 (Nasalgen IP, Coopers Animal Health). The calves were weaned on September 8 and randomly assigned to one of several treatment groups designated A1, A2, A3, A4, B1, B2, B3 and B4. Experimental treatment for each of these groups differed in respect to weaning placement, vaccine, and route of vaccination (Table 1).

Table 1. Groups of experimental animals and treatment.

Group	No. of Animals	Treatment
A1	15	Pasture, Vira Shield 5 IM*
A2	15	Pasture, Vira Shield 5 SQ**
A3	15	Pasture, Triangle 4 IM
A4	15	Pasture, Triangle 4 SQ
B1	14	Drylot, Vira Shield 5 IM
B2	15	Drylot, Vira Shield 5 SQ
B3	13	Drylot, Triangle 4 IM
B4	10	Drylot, Triangle 4 SR

*IM – intramuscular administration
**SQ – subcutaneous administration

The vaccines contained infectious bovine rhinotracheitis (IBR), parainfluenza type 3 (PI-3) and bovine virus diarrhea (BVD) viruses and were Vira Shield 5 from Grand Laboratories or Triangle 3 from Fort Dodge Laboratories. Two doses of each vaccine were administered with a 30-day interval between vaccinations. Calves were bled for serum at the start of the experimentation and at 20, 50 and 70 days thereafter. Sera were tested with virus neutralization tests for antibodies to BVD type 1 and type 2 viruses, IBR virus and PI-3 virus.

An analysis of variance was used to analyze the data. Initially, the data were analyzed as a 2 x 2 x 2 (housing, vaccine, injection site) factorial. This analysis indicated that housing had no real effect on antibody responses. Because the animals were all housed together (on pasture, or in the lot) a second analysis using housing as a blocking factor was performed. Vaccine and injection site were handled as a 2 x 2 factorial. The probability values from this second analysis are reported.

Results

Antibody responses of the experimental calves are indicated in Tables 2, 3, and 4. Increased titers to IBR and PI-3 viruses by the second bleeding indicated a positive response to the intranasal vaccine administered at the start of the experimentation.

Weaning location did not have a significant effect on the response of calves to vaccination although levels of antibodies to each of the viruses at the end of the experimentation was higher in the drylot-weaned calves (Table 2). Route of inoculation did not significantly influence the humoral responses to vaccination (Table 3). At the final bleeding, antibody levels were somewhat higher in calves vaccinated by the subcutaneous route but the difference was statistically significant only with antibody titers to BVD type 2 virus.

The most dramatic effect was the higher level of antibodies in Vira Shield vaccinated calves compared with Triangle vaccinates (Table 4). This effect was statistically significant and represented antibody responses to all the viruses.

Discussion

We had anticipated that the observed differences in stress of pasture- and drylot-weaned calves would influence the immune response to vaccination. However, this proved not to be the case. This finding may be due to a lack of stressful effects or to a long term induction activity on the part of the vaccines. These inactivated virus vaccines are adjuvanted and tend to prolong antigenic exposure of the immune system. This could potentially overcome the short-term effects of weaning stress. The responses of these calves to the oil adjuvanted vaccine were significantly greater than to the other vaccine. Inactivated virus vaccines have been criticized for a lack of immunogenicity. However, the findings indicate that this observation cannot be applied to all vaccines, and selection of a vaccine for use in young calves should be a primary consideration.

Table 2. Mean antibody titers of vaccinated calves weaned in drylot or on pasture. The number of animals was 60 on pasture and 52 in drylot.

		Date			
Virus	Location	8/19	9/8	10/8	10/28
IBR	Drylot	2.1	3.3	8.5	51.3
	Pasture	2.4	3.7	7.7	36.5
PI-3	Drylot	13.6	23.9	39.7	190.0
	Pasture	9.7	20.1	47.2	152.2
BVD-1	Drylot	7.1	4.9	3.1	34.8
	Pasture	10.9	6.4	3.6	24.1

Table 3. Mean antibody titers of calves vaccinated with inactivated virus vaccines by either the inramuscular (IM) or subcutaneous (SQ) route. The number of animals was 57 in the intramuscular group and 55 in the subcutaneous group.

		Date			
Virus	Route	8/19	9/8	10/8	10/28
IBR	IM	2.0	3.5	7.7	40.8
	SQ	2.4	3.5	8.5	45.9
PI-3	IM	10.8	20.3	46.2	159.8
	SQ	12.3	23.8	40.2	179.8
BVD-1	IM	7.6	4.9	2.8	24.4
	SQ	10.1	6.3	4.0	34.3
BVD-2	IM	2.4	2.1	2.0	6.9
	SQ	3.2	2.3	1.6	11.6*

*P<.05

Table 4. Mean antibody titers of calves vaccinated with two inactivated virus vaccines. The number of animals included 59 administered Vira Shield and 53 given Triangle vaccines.

		Date			
Virus	Vaccine	8/19	9/8	10/8	10/28
IBR	Triangle	2.6*	3.6	6.3	30.3
	Vira Shield	1.9	3.4	10.3*	61.8*
PI-3	Triangle	14.2	23.8	33.4	81.6
	Vira Shield	9.4	20.3	55.3*	352.1*
BVD-1	Triangle	7.7	7.5	3.7	17.9
	Vira Shield	6.3	4.2	3.0	46.5*
BVD-2	Triangle	3.8	2.8	1.7	2.1
	Vira Shield	2.1	1.8	3.6	37.8*

*P<.05

The route of administration did not affect the response to the viral components in these vaccines. The intramuscular route is recommended by the manufacturers. However, use of the intramuscular route with associated tissue damage and potential for hidden abcessation is being discouraged by the meat industry. When subcutaneous administration induces equivalent immune responses there is good reason to change to that route for vaccination.

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