Experimental Exposure of Feedlot Cattle to Infectious Bovine Rhinotracheitis Virus

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An axiom of infectious disease research states that significant numbers of animals with typical clinical disease must be observed to provide data for analysis. The morbidity rate of naturally occurring bovine respiratory disease (BRD) in feedlot cattle is frequently great enough to provide adequate data. In 2 successive years, the low incidence of respiratory disease in feedlot cattle at the Veterinary Medical Research Farm precluded analysis of the data. An alternative to the chance occurrence of spontaneous disease was experimental induction of BRD. Of the etiological trial of BRD, stress, virus and bacteria, a virus component appeared to provide the most potential for a controllable system. Exposure of cattle to pasteurella has given unpredictable results. A BRD inducing level of stress would be very difficut to simulate in large numbers of cattle. Aerosol exposure of calves to bovine herpesvirus-1 and 4 days later to *Pasteurella hemolytica* has been reported to consistently produce fibrinous pneumonia. The relationship of this experimentally induced disease to "shipping fever" is not clearly understood.[1] Although this model is useful for experiments designed with small numbers of calves, it did not fit the needs for a larger scale controlled clinical trial. Therefore, we elected to expose newly arrived cattle to infectious bovine rhinotracheitis virus (IBRV) in an attempt to initiate BRD. This report presents the results of trials conducted on each of 4 consecutive years.

Materials and Methods

The cattle were purchased by order buyers, usually at feeder calf sales, but some direct from the farm of origin. The points of origin varied from year to year, but included calves from North Carolina, Virginia, Tennessee and Kentucky. Histories of prior illness or treatment were not available. Processing of the cattle at the time of arrival included IM injection of 2.5 M units of vitamin A, implanting with zearolanone, ear tagging, weighing individually, deworming, and vaccinating with an attenuated bovine virus diarrhea virus as well as heptavalent clostridial bacterin-toxoid.

The IBRV was a low cell culture passage isolate from a severe clinical case. Four or 5 calves from each pen, selected for exposure by gate cut, received the virulent virus intranasally. The virus was administered intranasally by aerosol employing either a gas-powered atomizer or a syringe and a nasal catheter.[2] Pen contact provided exposure of the other calves in a treatment group.

The cattle were randomly assigned to treatment groups. Each treatment group was assigned to a separate barn with 6 replicate pens per barn except in trial 3, when 3 replicate pens were assigned to the IBRV exposed group. The first trial had 2 treatment groups; exposed to IBRV and unexposed controls. The protocol in trial 3 assigned 3 pens in the barn housing the IBRV exposed cattle to a fourth treatment group in which the virulent virus was administered in 1 nostril concurrently with modified live vaccine virus in the contralateral nostril of the calves.

Following establishment of the treatment groups precautions were taken to prevent the spread of the virulent virus to the other treatment groups. The control cattle were cared for first, i.e. fed, bedded, observed for clinical BRD or treated and in trials 2, 3 and 4 the vaccine virus group second and the virulent virus group last. Clothing was immediately laundered and boots thoroughly cleaned with an iodophor solution upon leaving the exposed cattle. Personnel did not return to the barns housing the unexposed cattle until the following day. The 3 barns, relative to each other, follow an approximate north-south axis with 200 to 300 meters separating them. The prevailing westerly to southwesterly winds and the intervening distance minimized the probability of airborne transmission of the virulent virus between barns. The IBRV group were housed in the barn nearest the facility for clothes change and laundry, which facilitated control of traffic flow.

The cattle were observed daily for 30 days for signs of

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BRD and any with rectal temperatures of 40.0 C. or higher received antimicrobials. Treatments was terminated when the rectal temperature was less than 40.0 C. on 2 successive days. The cattle in trial 3 were weighed at 30 and 144 days after the initiation of the study.

Results

Results of each of the treatment groups by trial are given in Table 1. The overall morbidity rate from the 4 trials of the cattle experimentally exposed to the virulent IBRV was 79.8% with little variability between trials. The incidence of BRD in the cattle in pen contact with the exposed cattle was markedly lower, 48.5% and varied between trials. The number of pen contact cattle treated for BRD varied from 30 of 85 (33%) in trial 2, to 67 of 84 (80%) in trial 4. Among the unvaccinated control cattle, 137 of 450 (30.4%) were treated for clinical BRD with a similar incidence of about 30% in each trial. Ninety seven of 330 cattle (29.4%) that received the modified vaccine IBRV had clinical BRD and were treated. The incidence varied between trials from 18 of 114 (16%) in trial 2, to 28 of 108 (26%) in trial 3, and 51 of 108 (47%) in trial 4.

The overall mortality rates for the 4 groups were 30% for the cattle experimentally exposed to IBRV and 9.1% for the pen contact cattle, vaccinated 2.7 and unvaccinated controls 3.6% (Table 1). The actual numbers of deaths in the experimentally exposed and pen contact cattle was almost identical, but the greater number of pen contact cattle resulted in the lower death rate. (Table 1). Examination of all cattle that died consistently revealed lesions of fibrinous pneumonia, sometimes hemorrhagic or necrotic in nature. *Pasteurella hemolytica* was the most frequently isolated bacteria.

The incidence of BRD in the subsets of IBRV exposed cattle in trial 3 was approximately 50% higher in the unvaccinated-exposed than in the vaccinated group and 3 in the vaccinated group. The unvaccinated-exposed cattle did not respond as well to treatment of BRD requiring an average of 6.8 treatments per animal as compared to 4.6 treatments for the vaccinated-exposed. The performance measured as average daily gain was 1.43 for the vaccinated cattle and 1.02 for the unvaccinated at the end of 30 days and 1.88 and 1.96 at 144 days. (Table 2).

TABLE 1. Experimental Exposure To Infectious Bovine Rhinotracheitis Virus.

	Number of Animals					
	Trial				Total	%
Principles	1	2	3	4		
Virus Intranasally	24	29	12	24	89	—
Treated for BRD	20	22	10	19	71	80
Died	8	11	3	5	27	30
Controls						
Pen Contact	96	85	42	84	307	—
Treated for BRD	36	30	16	67	149	49
Died	9	11	3	5	28	9
Non-Exposed						
Vaccinated	0	114	108	108	330	—
Treated for BRD	0	18	28	51	97	29
Died	0	2	1	6	9	3
Non-Exposed						
Unvaccinated	120	114	108	108	450	—
Treated for BRD	39	24	36	38	137	30
Died	7	4	1	4	16	4

TABLE 2. Concurrent Intranasal Vaccination and Exposure to Virulent Infectious Bovine Rhinotracheitis Virus.

	Number of Animals	
	Vaccinated	Unvaccinated
Exposed to IBRV	12	12
Treated for BRD	6	10
Died	2	3
In Pen Contact	42	42
Treated for BRD	11	16
Died	1	3
Total	54	54
Treated for BRD	17	26
Died	3	6
Number of Treatments for BRD		
Total	79	177
$\bar{x}$ per Calf	4.6	6.8
Average Daily Gain		
First 30 Days	1.43	1.02
144 Days	1.88	1.96

Discussion

Exposure to virulent IBRV at the time cattle entered the feedlot significantly increased the incidence of BRD, 79.8% in the experimentally exposed and 48.5% in the pen contact animals compared to an incidence of approximately 30% in the non-exposed groups. Eighteen of the 89 exposed animals did not develop clinical BRD. These animals may have had adequate protective immunity to withstand the challenge of the intranasal exposure to IBRV. The random assignment should have assured a similar distribution of resistant animals among the animals exposed by pen contact. Thus, approximately 60 of the 307 contact animals could have been resistant to exposure to IBRV. Of the 247 pen contact animals that could have been considered susceptible, 149 or 60% were treated for BRD.

The mortality rate was significantly higher in the experimentally exposed cattle (30%) than in the pen contacts (9%) ($P<0.005$) and in the groups not exposed to virulent IBRV, 2.7% for the vaccinated and 3.6% for the unvaccinated cattle ($P<0.005$), but not as great as that between the experimentally exposed and the unexposed groups.

The exposure to virulent IBRV did induce severe BRD. The higher morbidity and mortality in the pen contact cattle as compared to the cattle not exposed to IBRV indicates that the virus did spread by pen contact. However, the disease

was not as overwhelming in the contact cattle as in those experimentally exposed. A lower level of exposure to the virus by contact as compared to the experimental exposure could account for the difference in the incidence and severity. The greater overall incidence and severity of BRD in the exposed group as compared to the other 2 treatment groups indicates that the virulent virus did not spread between barns. The similarity of the 2 non-exposed groups further substantiates the containment of the virulent virus.

Vaccination intranasally with a modified live IBRV at the time of processing did not materially affect the incidence or severity of BRD as compared to the unvaccinated group. The overall morbidity and mortality for the 4 trials were essentially identical. There were differences within trials. A single trial could be selected that could indicate either a negative, trial 4, or positive, trial 3, response to vaccination. These results emphasize the need to replicate clinical trials with feedlot cattle with no history of prior disease, vaccination or exposure.

Concurrent exposure to the virulent IBRV and intranasal vaccination of the exposed cattle and the pen mates in trial 3 modified the subsequent disease. The overall incidence of BRD was reduced from 26 to 17 (35%), deaths from 6 to 3 (50%) and the average number of treatments per animal by one-third among the vaccinated compared to the unvaccinated animals. These data should not be interpreted as a beneficial effect of vaccinating in face of an outbreak. Exposure and vaccination were concurrent. The incubation period following exposure of susceptible cattle to IBRV varies from 2 to 6 days. The incubation period may have been adequate time for an immune response to the modified virus to be initiated that modified the severity of the viral infection. Further, the modified virus may have induced higher levels of interferon that provided protection. The performance of the 2 groups during the 144 day feeding period was not remarkably different. At the end of the first 30 days, the cattle that had not been vaccinated had gained less than half as much as the untreated counterparts. This difference had been compensated for by the end of the trial.

Summary

Aerosol exposure of feedlot cattle to virulent IBRV significantly increased the morbidity and mortality to BRD as compared to unexposed control groups. The respective mortality and morbidity rate for the exposed cattle were 79.8% and 30%, for cattle in pen contact with the exposed cattle 48.5% and 9.1% and approximately 30% and 3% for the control cattle. Intranasal vaccination with a modified IBRV did materially affect the incidence or severity of BRD as compared to unvaccinated groups. Concurrent exposure to virulent IBRV and intranasal vaccination, not to be considered vaccination in face of an outbreak, reduced the incidence of BRD 35%, deaths 50% and the average number of treatments per animal by 33%.

References

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