The Effect of Intranasal IBR-PI3 Vaccination of Feeder Cattle on Arrival at a Feedlot Compared with Vaccination at the Start of an Outbreak of Acute Respiratory Tract Disease

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Summary

Two controlled studies on the use of an intranasal vaccine containing modified live viruses of infectious bovine rhinotracheitis (IBR) and parainfluenza 3 (PI3) are described. In trial 1, 43 Hereford heifers 6-9 months of age were vaccinated intranasally with modified live IBR-PI3 vaccine. Forty calves were penned separately as unvaccinated controls. Fifty-five percent of the controls were treated for acute respiratory disease and one died. Thirty-five percent of the vaccinated calves were treated. Although this difference was significant, the rate of gain and feed efficiency in the two groups for the 46 days of observation were nearly identical. A natural infection with PI3 virus was demonstrated in the control group.

In the second trial, 75 Hereford heifers were purchased at a terminal market and shipped to a feedlot in four different groups. Forty-nine calves were vaccinated intranasally with IBR-PI3 virus 3 to 7 days after shipment at the onset of an outbreak of acute respiratory tract disease. Twenty-six calves were left as unvaccinated controls. The difference in number of calves treated was not statistically significant, but vaccinated calves had a more protracted disease, one death, and much lower feed efficiency.

Intranasal vaccination of cattle with IBR-PI3 vaccine is a common practice for the prevention of respiratory disease caused by these two agents. Local immunity of the respiratory tract three days following intranasal vaccination is a reported advantage (Todd, 1973). Until preconditioning of feeder cattle is widely used, alternative methods of controlling feedlot respiratory diseases need to be investigated (Anon, 1968). The following report describes the use of intranasal IBR-PI3 virus vaccine in feeder cattle on arrival at a feedlot, compared with unvaccinated controls, and in a second study the vaccine was given at the onset of an outbreak of acute respiratory tract disease. Unvaccinated calves served as controls.

Materials and Methods

Trial 1

Eighty-three Hereford heifers 6 to 9 months old were purchased October 5, 1973, at a feeder cattle auction and transported a short distance to a feedlot. These calves were raised in southern Illinois and originated from 37 different farms. On arrival each animal was weighed, and a blood sample and nasal swabs were collected. Serum was separated from the blood and stored frozen until tested for antibodies against PI3 and IBR viruses. Nasal secretions were placed in tissue culture medium, frozen, and stored until assayed for cytopathic agents. Fecal samples were collected and examined for eggs of gastrointestinal nematodes. Later, each animal was injected with Ripercol®. Forty-three of the heifers were vaccinated intranasally with Nasalgen I-P (modified live bovine parainfluenza-3 and bovine infectious rhinotracheitis virus for intranasal administration. Jensen-Salsbury Laboratory, Kansas City, Mo.) and 40 were maintained as unvaccinated controls. The two groups were penned separately. Seven weaned feeder calves 6 to 8 months of age from the veterinary medicine research beef herd at Dixon Springs Agricultural Center were handled similarly and placed with the vaccinated heifers as contact controls.

All animals showing signs of depression, anorexia, increased respiration rate, lacrymation, excess nasal discharge, and rectal temperature of 104° F or above were treated daily with antimicrobial agents as described earlier until the rectal temperature returned to normal (Woods et al, 1973). A blood sample, nasal and fecal swabs were obtained for virologic testing.

After the clinical cases of respiratory tract disease subsided, blood samples were again taken for determination of antibody titers to IBR and PI3 viruses. The cattle were weighed on October 5 and 19, and November 20. All feed concentrates were weighed and recorded. The ration consisted of fescue hay and pasture, and a concentate containing 45% ground

corn, 45% wheat, and 10% soybean oilmeal. Feed efficiency was calculated on the amount of concentrate fed.

Trial 2

Seventy-five Hereford heifers, 6 to 10 months old, were purchased at auction at the East St. Louis, Illinois, stockyards in four groups between January 1, 1974 and March 1, 1974, and moved 200 miles to a feedlot. Animals within each group were divided into two lots as controls and vaccinates (Table 1). Each animal was handled on arrival as previously described, except vaccination with Nasalgen I-P was given as indicated in Table 1. Criteria for treatment, collection of specimens, weighing, and ration were identical to Trial 1. Of the 75 calves 49 were vaccinated and 26 served as unvaccinated controls.

Laboratory Procedures

Cell Culture: Madin-Darby bovine kidney (MDBK) cells were grown in tubes with Eagle's minimal essential medium (MEM) with nonessential amino acids, glutamine, 0.5% lactalbumin hydrolysate plus 10% bovine fetal serum, and antibiotics. Maintenance medium consisted of MEM containing 2% bovine fetal serum. All mediums contained 200 units of penicillin, 200 μg of amphotericin B per milliliter.

Virus Isolations: Each nasal and fecal specimen was inoculted into 0.2 ml amounts into each of 3 MDBK cell cultures. The cells were incubated at 36°C and observed each day for cytopathic effect (CPE). After 5 days of incubation all negative cultures were tested by the hemadsorption (HAD) technique using guinea pig erythrocytes. The cells and fluid from the HAD negative tubes were passed once following a freeze and thaw cycle. Toxic specimens were blind passed once.

Bacteriologic Studies: Nasal swabs were streaked directly on blood agar plates. Identifiction of the organisms was made by standard bacteriologic methods.

Serologic Tests: Hemagglutination-inhibition (HI) tests were performed by the microtiter technique using guinea pig erythrocytes and the SF_4 strain of bovine parainfluenza-3 (PI3) virus.

Serum neutralization (SN) tests were performed by microtiter technique using MDBK cells and the Colorado I strain of infectious bovine rhinotracheitis (IBR) virus. All serums were heat inactivated at 56°C for 30 minutes. Serums for HI tests were further treated with Kaolin and absorbed with guinea pig erythrocytes. Serum neutralization titers of 1:2 and HI titers of 1:20 or greater were considered positive.

Results

Trial 1

Clinical Findings: Thirty-five (35%) percent of the vaccinated calves were treated for acute respiratory tract disease, compared to 55% of the unvaccinated control calves and 57% of the contact controls. This difference was statistically significant at the .05 level of probability. The average cost of drugs for treatment was $1.00/calf in the vaccinated group and $1.35 in the control lot. The rate of gain and feed efficiency was slightly greater (3.2 compared to 3.0) in the vaccinated animals. These results are summarized in Tables 2 and 3. One control calf died of acute pneumonia. The egg counts for gastrointestinal nematodes averaged 1,793 eggs per gram of feces in the vaccinates and 1,367 E.P.G. of feces in the controls when sampled at the start of the study. Three weeks after worming egg counts were negative in both groups.

Trial 2

Sixty-eight (68%) percent of the vaccinated calves and 50% of the control calves required treatment for acute respiratory tract disease. This difference was not statistically significant at the .05 level but was at the 0.1 level. The cost of drugs for treatment per calf was $6.40 for the vaccinates compared to $3.60 for the controls. Treatment of respiratory tract disease was also more protracted than in unvaccinated calves. These results are summarized in Tables 2 and 3. Calves were treated from February 4, 1974, through March 21, 1974. One calf in group 1 died 5 days after arrival with acute pneumonitis before vaccination. *Pasteurella multocida* and *P. hemolytica* were isolated from the lung. The weights are calculated on the basis of 44 vaccinates with complete data. The egg counts for gastrointestinal nematodes at the start of trial 2 averaged 1,384. Three weeks after worming egg counts were 0 except in two calves.

Table 1
Date on Calves in Trial 2

	Date of Arrival	Numbers Controls	Numbers Vaccinates*	Date of Onset of Illness and Vaccination
Group I	1-22-74	6	11	1-29-74
Group II	2- 1-74	11	18	2-06-74
Group III	2-22-74	4	10	2-25-74
Group IV	3- 1-74	5	10	3-06-74
Totals		26	49	

*Vaccinated with Nasalgen I-P, modified live bovine parainfluenza-3 and infectious bovine rhinotracheitis vaccine, Jensen-Salsbury Lab., Kansas City, Missouri.

Table 2
Comparison of Acute Respiratory Tract Disease and Frequency and Cost of Treatment in Vaccinated and Unvaccinated Calves

	No. Calves	No. Treated	Treated	No. of Treatments 1	2	3	4	Total	Total Cost of Treatment***	Average Cost per Calf Treated	No. Died
Controls	40	22	55%	25	23	10		58	55.00	1.35	1
Vaccinated*	43	15	35%	20	17	10		47	43.00	1.00	0
Contact Controls with Vaccinates	7	4	57%	7	5	4		16	13.00	1.85	0
Trial 2											
Control	26	13	50%	11	7	39	41	98	94.00	3.60	0
Vaccinates*	49	36**	68%	40	33	120	167	360	341.00	6.40	1

*Vaccinated intranasally with Nasalgen I-P, modified live bovine parainfluenza-3 and infectious bovine rhinotracheitis vaccine, Jensen Salsbury Lab., Kansas City, Mo.
**1 calf fied and is included in the totals.
***Cost of drugs only.

Table 3
Weight Gains, Feed Conversion, and Average Daily Gain In Vaccinated and Control Calves

Group	No.	Weight at Start	Weight	Gain	Daily Gain	Lbs. Concentrate Fed / Lbs. Gained
Trial 1						
Vaccinated[1]	43	16,820 lbs.	19,460*	15.7	1.1 lbs.	3.2
Control	47	15,450 lbs.	17,715*	14.7	1.2 lbs.	3.0
Trial 2						
Vaccinated[2]	48	19,790 lbs.	21,890**	10.6	0.6 lbs.	5.6
Controls	26	10,720 lbs.	12,110**	13.0	0.7 lbs.	4.4

*47 days after arrival.
**76 days after arrival.
***As a percentage of purchase weight.
[1]Vaccinated after shipment with Nasalgen IP, modified live bovine parainfluenza-3 and infectious bovine rhinotracheitis vaccine, Jensen-Salsbury Lab., Kansas City, Mo.
[2]Vaccinated 5 to 7 days after arrival or at start of outbreak of clinical acute respiratory tract disease with Nasalgen IP, Jensen-Salsbury Lab., Kansas City, Mo.

Laboratory Results

Trial 1

A virus identified as PI3 was isolated from 1 animal in the non-vaccinated group on the day of arrival. Between the 5th and 19th day after entering the lots, 8 IBR viruses believed to be vaccine virus were the only viruses recovered from the vaccinated animals during the time of illness.

Five calves out of 61 (8.2%) had a titer of 1:20 or greater to PI3 on day of arrival. Changes in serologic profiles of treated calves for PI3 antibodies during the first 46 days in the feedlot are presented in Table 4. A significant serologic rise was demonstrated in 19 (86.4%) of the 22 control calves. Positive seroconversion to PI3 virus in the vaccinated group receiving treatment was 85.7%. A summary of the HI results in trial 1 following the disease outbreak is presented in Table 5. Fifty percent of the titers in the control group were 1:80 or greater compared to 35.7% in the vaccinated group. None of the 33 sick non-vaccinated animals showed a seroconversion to IBR virus during the first 46 days in the feedlot, whereas 21 of the 24 (87.5%) vaccinated animals tested had IBR antibodies. Of 61 calves tested on day of arrival, one had IBR antibodies. One contact animal had seroconverted to IBR when tested after 46 days in the lot.

Table 4
Serologic Profiles of Calves Treated in Trial 1 During First 46 Days in the Feedlot

Change in titer to PI3 virus	Animals Control	Vaccinated*
Rise	19	12
No change	1	0
1:10 or negative	2	2
Totals	22	14

*Vaccinated after shipment with Nasalgen IP.

Pasteurella multocida and *hemolytica* were isolated with equal frequency from both groups of calves on day of arrival and during the illness. The number of isolations were greter during the outbreak.

Trial 2

Two PI3 virus isolations were made at the time of arrival in the feedlot from calves in group 2 and one from a control calf during respiratory illness. IBR and PI3 viruses were isolated from sick animals following vaccination, and these isolates were presumed to be of vaccine origin.

The percent of control and vaccinated animals with PI3 antibodies at the beginning of the study were

Table 5
Frequency Distribution of Hemagglutination Inhibition (HI) Titers on Control and Vaccinated Calves in Trial 1 Following Disease Outbreak

Status	Reciprocal of antibody titer									
	10	20	40	80	160	320	640	1280	2560	Total
Vaccinated*	2	6	10	3	6	0	1	0	0	28
Control	2	7	7	6	6	3	0	0	1	32
Totals	4	13	17	9	12	3	1	0	1	60

*Vaccinated after shipment with Nasalgen IP.

Table 6
Serologic Reactivity of Bovine Serums in Trial 2 Before and Following Natural Infection with PI3 and Vaccination with PI3 and IBR

Determinant	Time	PI3 Positive*			IBR Positive**		
		No. Tested	No.	%	No. Tested	No.	%
All cattle	On arrival	56	25	44.6	56	8	12.5
Controls	On arrival	13	5	38.5	21	2	9.5
Controls	After illness	13	11	84.6	21	2	9.5
Vaccinates‡	On arrival	43	20	46.5	43	6	14.0
Vaccinates‡	After illness and vaccination	42†	35	83.3	42	37	88.1

*Antibody measured by HI test.
**Antibody measured by SN test.
†One animal died 5 days after arrival.
‡Vaccinated with Nasalgen I-P.

similar. Following illness 84.6% of the control calves and 83.6% of the vaccinates tested had seroconverted to PI3. Eight (12.5%) of 56 calves tested on day of arrival had antibodies to IBR virus. None of the calves in the control group seroconverted to IBR during illness whereas 31 (73.8%) of 42 vaccinates had IBR antibodies. These results are summarized (Table 6).

Discussion

Trial 1

Vaccination at the time of arrival, under the conditions of this study, resulted in a less severe respiratory tract disease and slight advantage in feed conversion without death loss. Weight gains were decreased slightly during the first 3 weeks after vaccination when compared to controls. The cost-benefit ratio was better in the vaccinated group as a result of the combined effect of less clinical disease, better feed converson, less cost of treatment and no death loss. However, death of the one control calf accounted for the major difference.

The apparent minimal PI3 virus shedding on day of arrival is of special interest since the disease outbreak was observed 6 days after entering the feedlot. Although PI3 virus was not recovered during illness, the seroconversions after entering the feedlots are evidence of exposure of the unvaccinated animals to the virus. The low serologic activity demonstrated in the acute serums indicates that the animals were a susceptible population. Failure to isolate PI3 virus during the acute illness highlights the perplexing problem in determining the cause of feedlot respiratory diseases by isolation studies only.

Transfer of IBR vaccine virus to contact animals with seroconversions has been reported (McKercher and Crenshaw, 1971). Feeder calves obtained from southern Illinois showed little evidence of IBR infection. This is in contract to the 12.5% IBR serologic positive animals obtained from the East St. Louis, Illinois, stockyards (trial 2) which originated from unknown geographic areas. It is interesting to note that the controls and vaccinated animals in each trial had similar percent of seroconversions to PI3 virus. Vaccination immediately after shipment of feeder calves that had been in an auction market four days had merit under the conditions of this study (trial 1). It is emphasized tht these animals were free of clinical signs of illness at the time of arrival to the feedlot.

Trial 2

The acute respiratory tract disease in this study was characterized by its high prevalence and protracted nature. More vaccinated calves were treated than controls but the difference could have occurred by chance. However, vaccinated calves had a much higher cost of treatment and their feed efficiency was much less than the control calves. Therefore, under the conditions of this study, vaccine should not have been administered. The calves in this study were purchased from a large terminal market and their history and duration of exposure was not known. Results from vaccination may have been improved had they been vaccinated at the time of arrival in the feedlot. Vaccination of sick animals is an additional stress to the animal and is not recommended.

These results show that PI3 infections continue to be a problem in assembled feeder calves. Specific preventive measures should therefore be

directed toward pre-exposure vaccination. The safety and efficacy of the vaccine used in this study has been demonstrated in healthy animals (Todd, 1974; Woods et al, 1975).

A preconditioning program described earlier for southern Illinois feeder calves markedly reduced clinical respiratory disease after shipment to the feedlot (Woods, et al., 1970).

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