A Field Trial, of Preshipment Vaccination, with Intranasal Infectious Bovine Rhinotracheitis-Parainfluenza-3 Vaccines

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ABSTRACT

A total of 849 calves, 278 controls, 335 vaccinated intranasally with IBR-PI_3/TS and 236 vaccinated intranasally with IBR-PI_3/PTC were studied in a field trial of preimmunization. All calves were vaccinated in Saskatchewan at least three weeks prior to shipment to feedlots.

Four hundred and twenty six calves were not sold within eight weeks of vaccination; however, seven of these died within four weeks of vaccination. Treatment rates varied from 1.0% to 5.2%. There was no significant effect of vaccination on treatment rates. Similarly, there was no significant effect of vaccination in the 74 calves sold to feedlots in Saskatchewan.

Three hundred and forty nine calves were sold to feedlots in Ontario. Two of these died from fibrinous pneumonia. Treatment rates varied from 1.7% to 33.3% in different feedlots, but there was no significant effect of vaccination on treatment rates. Therefore, preimmunization is unlikely to significantly reduce the overall treatment rate in calves entering feedlots.

RÉSUMÉ

Cette étude portait sur une expérience de vaccination et impliquait 849 veaux dont 278 servirent de témoins, tandis que 335 reçurent une dose intranasale du vaccin IBR-PI_3/TS et 236 autres reçurent une dose intranasale du vaccin IBR-PI_3/PTC. Tous ces veaux furent vaccinés en Saskatchewan, au moins trois semaines avant leur transport dans des parcs d'engraissement.

On laissa écouler au moins huit semaines avant de procéder à la vente de 426 de ces veaux; sept d'entre eux moururent toutefois dans les quatre semaines qui suivirent leur vaccination. Les taux de traitement varièrent de 1% à 5,2% et ne subirent pas d'influence appréciable de la part de la vaccination; elle n'exerça pas non plus d'influence appréciable sur les 74 veaux qui se retrouvèrent dans des parcs d'engraissement de la Saskatchewan.

Par ailleurs, des propriétaires de parcs d'engraissement d'Ontario achetèrent 349 de ces veaux, dont deux moururent de pneumonie fibrineuse. La vaccination n'exerça aucune influence significative sur les taux de traitement qui varièrent de 1,7% à 33,3% dans divers parcs d'engraissement. L'immunisation des veaux avant leur transport dans les parcs d'engraissement ne semble donc pas apte à réduire de façon appréciable le taux global de traitement des veaux qui arrivent dans les parcs d'engraissement.

INTRODUCTION

The pathogenesis of shipping fever (fibrinous pneumonia, pneumonic pasteurellosis) is complex and inadequately understood; although the syndrome accounts for the majority of treatments in cattle in the first few weeks after arrival in a feedlot (11,20). Stress such as, energy deficiency, dehydration and increased levels of adrenal steroids, or viral, or mycoplasma, infection probably predispose the respiratory tract to damage by bacteria, most commonly *Pasteurella haemolytica* or *multocida*. Under controlled conditions pneumonic pasteurellosis may be reproduced by the direct infusion of large numbers of *Pasteurella* into the trachea, or by aerosol challenge with *P. haemolytica* four to five days after aerosol challenge with infectious bovine rhinotracheitis (IBR) virus (17) or, more recently, parainfluenza type 3 (PI_3) virus (7). Stockdale *et al* demonstrated, using the IBR model, that vaccination against IBR prevented the disease, but did not work as well when some of the calves were stressed by transportation (17). The potential role of *Mycoplasma* in some of these studies has been discussed (8).

Observational studies have indicated that vaccination of calves, shortly after arrival in the feedlot, may produce more harm than benefit (1,5,11); whereas others report no effect of vaccination on treatment rates (6). To date, no comprehensive experimental field trials have been conducted to validate or refute these findings. Last year, we initiated a field trial to investigate the efficacy of two intranasal vaccines, each containing IBR and PI_3 viruses. Although

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the number of calves was small, and farm effects could not be ruled out, the results suggested that a temperature-sensitive variant of IBR virus was effective in reducing treatment rates, when administered at least three weeks prior to shipment to Ontario feedlots (Unpublished data). This study provides additional data to evaluate the two IBR-PI_3 intranasal vaccines, given three to six weeks prior to shipment.

MATERIALS AND METHODS

Ten cattle owners, in central and southern Saskatchewan, collaborated in the project. Each was paid a handling fee for processing their calves and the number of calves per farm varied from 11 to 410. If the calves were sold, the purchasers were identified and asked to maintain treatment records. Each purchaser was paid one dollar per head plus any costs associated with necropsy of dead calves for collaboration and record keeping.

Two vaccines were used, one was of porcine tissue culture origin (IBR-PI_3/PTC)[1] and the other was of bovine tissue culture origin and contained a temperature sensitive mutant of IBR virus (IBR-PI_3/TS).[2] The vaccines were purchased from a retail outlet, stored and administered according to manufacturer's instructions. All calves received a clostridial bacterin at the same time as the IBR-PI_3 vaccine. Two thirds of the calves were systematically assigned, on an individual animal basis within each herd, to receive an IBR-PI_3 vaccine. Only one of the IBR-PI_3 vaccines was used in each herd of origin. Vaccination was performed a minimum of three weeks prior to shipment, and the calves remained with the cows for at least three weeks. All calves were identified with an ear-tag.

Data on treatments, for any reason, or deaths, and all other pertinent information about the calves were entered into computer files. Preliminary analyses were performed using cross-tabulation and linear model techniques (16) and final analyses were performed using logistic regression (BMDP PLR) (4). The latter technique allowed control for the effects of year, source of calves and feedlot, concomitant with the estimation of vaccine effects. The vaccine effects and their standard error were based on the natural logarithm of the odds-ratio, with the nonvaccinated calves as the comparison group having an odds ratio equal to one.

RESULTS

A total of 849 calves on ten ranches was studied, 426 of these remained at the source ranch, seventy four calves were sold to eleven feedlots in Saskatchewan and 349 were sold to fifteen feedlots in Ontario. Three Ontario feedlot owners purchased a total of 197 calves from one source.

In total, nine calves died; seven of these within four weeks of processing and before leaving the original farm. Four of these were unvaccinated and three were vaccinated with IBR-PI_3/TS. No necropsy examinations were conducted on these calves. Two other calves died after arrival in Ontario and both were vaccinated, one with the IBR-PI_3/TS vaccine, the other with the IBR-PI_3/PTC vaccine. Fibrinous pneumonia, was the predominant lesion in these two calves.

A. CALVES REMAINING AT THE FARM OF ORIGIN

Among the 426 calves remaining at the farm of origin no calves vaccinated with IBR-PI_3/PTC vaccine, less than five percent of IBR-PI_3/TS vaccinated calves and three percent of nonvaccinated calves required treatment. There were no significant differences in rates of treatment between either vaccine group and the control calves (Table I).

B. CALVES SHIPPED TO FEEDLOTS IN SASKATCHEWAN

Feedlot owners in Saskatchewan purchased only a few of the calves on this study, mainly from one presorted calf sale. Although feedlot to feedlot variation in treatment rates was large, no significant differences in treatment rates between either vaccine group and the control calves were noted (Table II).

TABLE I. Treatment Rates in Calves Staying on the Ranch of Origin 1981-82

Farm Number	Vaccine			Average Treatment Rate
	None	IBR-PI/TS	IBR-PI/PTC	
1	4.9%(4/81)	5.3%(7/132)	—	5.2%
2	0.0%(0/27)	3.8%(2/53)	—	2.5%
3	2.3%(1/44)	—	0.0%(0/89)	1.0%

(Number Treated/Number of calves)

TABLE II. Treatment Rates in Calves Transported to Feedlots in Saskatchewan 1981-82

Feedlot Number	Vaccine			Average Treatment Rate
	None	IBR-PI/TS	IBR-PI/PTC	
1	0.0%(0/16)	—	0.0%(0/26)	0.0%
2-5[a]	14.2%(1/7)	0.0%(0/4)	28.6%(6/21)	21.9%

(Number Treated/Number of calves)
[a]Feedlots with less than eleven study calves, in total
Based on analysis of variance, there are significant differences between feedlot 1 and feedlots 2-5 combined. There were no significant differences between vaccines and the control group. No further analyses were performed on these data

[1]Contravac, Connaught Laboratories Ltd., Willowdale, Ontario.
[2]TSV-2 Norden, Lincoln, Nebraska.

C. CALVES SHIPPED TO FEEDLOTS IN ONTARIO

Significant differences in treatment rates existed among source farms and feedlots, but not among vaccine groups (Table III) based on the 349 calves shipped to feedlots in Ontario. Treatment rates for calves in the 1980-81 study, using the same vaccines are shown for comparison. Including these data in the analysis while controlling for year effects, source and feedlot, failed to reveal any significant benefit of either vaccine. In the 1980-81 study, if source and feedlot were ignored, the rate of treatment in IBR-PI_3/TS vaccinated calves (10%) was less than in the nonvaccinated or IBR-PI_3/PTC vaccinated calves (35% and 37% respectively). However, when source and feedlot were considered the differences were reduced. For example, in feedlots receiving IBR-PI_3/TS vaccinated calves, the rates of treatment in IBR-PI_3/TS vaccinated calves was 10% (3/30) and 20% (2/10) in nonvaccinated calves from the same source. This difference is not significant at $p<0.05$ ($\chi^2<1.0$). In the same feedlots, the treatment rate in calves from other sources was 46% (11/24).

The summary odds ratios, and their 95% confidence intervals relating the rate of treatment in each vaccine category to the control group, for calves staying on the farm of origin and those sold to Ontario feedlot owners are shown in Table IV. The standard errors are quite large and the 95% confidence intervals reflect this feature. Since the confidence intervals bracket unity, the odds ratios are not significant. Thus, neither vaccine appeared to produce any practical reduction of treatment rates.

TABLE III. Treatment Rates in Calves Shipped to Feedlots in Ontario, 1980-81, 81-82

Year	Feedlot	Vaccine			Average Treatment Rates
		None	IBR-PI/TS	IBR-PI/PTC	
1981-82	1-S1	1.9%(1/35)	2.9%(1/78)	—	1.7%
	2-S1	28.5%(2/7)	34.5%(10/28)	—	33.3%
	3-S1	0.0%(0/12)	2.7%(1/37)	—	2.0%
	4-S2	6.7%(1/15)	—	6.1%(2/33)	6.3%
	5	0.0%(0/7)	—	15.3%(2/13)	10.0%
	6-S2	50.0%(6/12)	—	21.9%(7/32)	29.5%
	7-14[a]	0.0%(0/15)	0.0%(0/3)	13.6%(3/22)	6.4%
1980-81	15	25.0%(2/8)	0.0%(0/21)	0.0%(0/1)	6.7%
	16	47.6%(10/21)	—	45.5%(21/44)	47.7%
	17	0.0%(0/9)	—	5.9%(1/17)	3.8%
	18	50.0%(5/10)	33.0%(3/9)	40.0%(6/15)	41.2%

(Number Treated/Number of calves)
S1 and S2 identify two farms of origin for a large proportion of the calves under study in 1981-82
[a]Feedlots with less than 11 study calves, in total
There are significant differences among feedlots and between years. There were no significant differences among vaccine categories

TABLE IV. The Effects of Vaccination on Treatment Rates in Calves 1980-81, 81-82

Calves staying on ranch of origin	Mean and 95 percent confidence interval for odds ratio, comparing rate of treatment in vaccinated and unvaccinated calves
IBR-PI/TS	10.5; 0.0 - 961 × 10
IBR-PI/PTC	0.12; 0.0 - 975 × 10
Calves shipped to Ontario feedlots	
IBR-PI/TS	0.94; 0.47 - 1.87
	0.83; 0.42 - 1.68[a]
IBR-PI/PTC	0.82; 0.28 - 2.36
	0.87; 0.30 - 2.50[a]

[a]Estimates derived after deleting all feedlot data if < 10 calves were present in that feedlot

DISCUSSION

In both years of study, owners were identified who had habitually sold their calves to purchasers from Ontario. Some of the calves went directly to Ontario, others went indirectly to Ontario via salesyards and still others were purchased by feedlot owners in Saskatchewan. Because the number of study calves, in any group of salesyard calves was small, some purchasers were not enthusiastic about cooperating in the study and many calves were lost to follow-up. Also, in 1981-82, poor market conditions reduced the demand for calves and many study calves were not sold during the fall of 1981.

Only crude treatment rates and mortality rates were available as measures of vaccine efficacy. However, no feedlot owners reported having to treat many calves for conditions other than what they presumed was respiratory disease. Although most reports indicate that the shipping-fever complex accounts for the majority of treatments given in the first few weeks after arrival, it would be extremely informative to collect cause-specific treatment rates and weight gain data in future field trials.

Given the above limitations, the data from our studies of preimmunization demonstrate that year, source of calves and feedlot were related significantly to treatment rates, but the vaccines *per se* had little effect on overall treatment rates. Although some of the odds ratios are less than unity, the standard errors are very large and thus it is difficult to estimate precisely the true effects of the vaccines. The low treatment rate

seen in 1981-82 made detecting differences in treatment rates difficult; however, even in groups of calves receiving extensive treatment, there was no significant effect of vaccination. Our current conclusion is that the apparent benefit of the temperature sensitive vaccine, noted in 1979-80, was probably due to the generally lower treatment rates of calves from one farm, rather than a true vaccine effect.

The results of this trial are concordant with published data on vaccination, against the shipping fever complex, since most vaccines appear to produce no benefit in terms of reduction of treatment rates or weight gains (12). The literature on vaccination prior to shipment is scanty and often the effects of vaccination are completely confounded with other aspects of preconditioning programs, such as weaning and creep-feeding, or vaccination after arrival in the feedlot. Two previous studies failed to demonstrate a statistically significant benefit from preconditioning; although, the authors noted an apparent benefit in one of the three years (18,19). (The overall odds ratio, comparing treatment rates in vaccinated to unvaccinated calves, was 0.948 and the limits of the 95% confidence interval were 0.759 and 1.185). Another study, gave equivocal results since more vaccinated than nonvaccinated calves were treated, but the cost per pound of gain was slightly less in vaccinated calves (13). The results of a recent study based on preconditioned calves from one salesyard, in Alberta, indicated that the preconditioned calves had significantly lower treatment rates than nonpreconditioned calves and that preimmunized calves (vaccinated, but not weaned) had intermediate levels of treatment, in Ontario feedlots. No benefit from preimmunization was observed in calves in western feedlots (2). At face value, these results might indicate that weaning and creep-feeding are more effective means of reducing treatment rates than vaccination *per se*.

The IBR-PI_3/PTC used in this trial has been effective in preventing shipping fever in controlled experiments; although it was less effective when some of the cattle were stressed by shipment (17). Thus, IBR and *P. haemolytica* are components of at least one sufficient cause (15) of pneumonic pasteurellosis, but the prevalence of these sufficient causes under feedlot conditions is unknown. That is, the amount of the shipping fever complex that may be attributed directly or indirectly to the IBR component is not known. Despite its inclusion in many vaccines, the importance of the PI_3 virus in the shipping fever complex seems slight, although this virus has recently been used prior to aerosol exposure to *P. haemolytica*, to produce fibrinous pneumonia (7). Although *Pasteurella* spp. are the predominant and major immediate cause of shipping fever, and thus of increased treatment rates, the proportion of feedlot calves that require treatment because of these bacteria, or viral-mycoplasma precursors is unknown. Recent work in feedlots in Texas (14) indicates that infection with bovine virus diarrhea (BVD) virus may be more important than infection with *Pasteurella* species; because a higher percentage of cases of respiratory disease seroconverted to BVD, than to *P. haemolytica*. It appears that if BVD is a precursor of shipping fever pneumonia, it does not reduce the pulmonary clearance of *P. haemolytica* (9). Nonetheless, infection with BVD appears to make calves, challenged with aerosols of *P. haemolytica* highly susceptible (3). At present, mounting evidence suggests that the health risks from vaccinating feedlot calves with live BVD virus outweighs any benefits (11,12), irrespective of its possible role in respiratory disease.

Some researchers have discussed the potential difficulty involved in conducting randomized — on an individual animal basis — field trials of vaccines, because the vaccinated majority would protect the unvaccinated minority, thus reducing the apparent effect of the vaccine (1). Since 70% of calves in this study were vaccinated, herd immunity might protect the unvaccinated calves. However, there were no apparent differences in vaccine effects over a wide range of treatment rates or vaccinated percentage within feedlots and thus the importance of herd immunity is reduced.

Thus, many important features of the shipping-fever complex remain to be elucidated. Immunoepidemiological studies to identify the risk from, and importance of, various putative pathogens, particularly the association among viruses, mycoplasma agents and *Pasteurella* sp. as causes of respiratory disease need to be performed. In the mean time, many feedlot owners and veterinarians will utilize vaccines with the hope of reducing treatments related to shipping fever. The results of this study suggest that preimmunization is unlikely to be of major benefit in this regard.

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