Assessing Passive Transfer and Respiratory Pathogen Colonization of Neonatal Beef Calves in a Confinement Operation

Russ Daly, Christian Rozeboom, and Jonathan Sumption

Objectives

1) Determine adequacy of passive transfer, and specifically Mannheimia hemolytica antibodies, in 2 subsets of neonatal calves.

2) Characterize presence and relative levels of respiratory pathogens – and changes over time – in nasal swabs in 2 cohorts of calves.

3) Use the results to determine whether changes in vaccine programs are warranted in this herd.

Study Description

1) Passive transfer study. Serum from 46 calves < 1 week of age was obtained over 4 weekly visits. Total protein was determined using refractometry. Calves with serum proteins > 5.5 mg/dl were deemed to have adequate passive transfer. *Mannheimia hemolytica* titers were determined using serum microagglutination; titers > 1:2048 were considered positive.

2) Respiratory pathogen study. Deep nasal swabs from a cohort of 10 calves (5 from heifers, 5 from 3-year-olds) were obtained weekly from 0-7 weeks of age, then again at 12 and 18 weeks of age. Samples from calves within a cohort were pooled into a single sample per visit, and the presence and relative abundance of BRSV, Bovine coronavirus, M. hemolytica, H. somni, P. multocida, and Mycoplasma spp. was determined using real-time PCR. Ct levels < 40 were considered positive.

Take home points

- Passive transfer was adequate in calves from both age groups (average 6.5 mg/dl), with only 6/46 calves below the 5.5 mg/dl threshold.
- Calves treated for any illness had lower serum protein levels (6.2 mg/ml, n = 9) vs. non-treated calves (6.6 mg/ml, n = 37).
- Serum protein levels did not correlate with *M. hemolytica* titers.
- Bacterial respiratory pathogens were commonly found in calves from both age groups. *M. hemolytica and H. somni* levels peaked at 6 weeks of age, while *P. multocida* was consistently present throughout the sampling period. *Mycoplasma* spp. was not found in any calves at any time point.

- Viral pathogens were found sporadically and were not consistently found following intranasal vaccination.
- The pre-calving vaccination and treatments at birth in this herd resulted in good passive transfer in this herd.
- Bacterial pathogens peaked in these calves at 6 weeks; vigilance for respiratory disease should concentrate around this age in this herd.
- Viruses from intranasal vaccines were not consistently found in nasal swabs in these calves, even right after vaccination.

Keywords: beef calves, confinement, passive transfer, respiratory disease

Assessing Passive Transfer and Respiratory Pathogen Colonization of Neonatal Beef Calves in a Confinement Operation

Russ Daly, Christian Rozeboom, and Jonathan Sumption

Abstract

A cow-calf herd calving in confinement with consistent respiratory disease in calves sought to characterize passive antibody transfer and respiratory pathogen colonization in calves. Calves born in February and March 2019 from heifers and 3-year old cows were sampled. Passive transfer was assessed using serum protein levels from weekly blood samples from calves 0-7 days of age. Samples were also assessed for *M. hemolytica*-specific antibodies via microagglutination. Nasal swabs were taken from a calf cohort from heifers and 3-year olds, pooled by cohort and assessed for the presence of BCV, BRSV, *Mycoplasma spp*., *M. hemolytica*, *H. somni*, and *P. multocida* using real-time PCR. Average serum protein was 6.5 mg/dl (range = 4.9-8.1 mg/dl), with 40/46 calves over the 5.5 mg/dl threshold. Heifers' calves had similar serum protein levels compared to 3-year-olds' calves. Calves treated for illness had lower serum protein levels (6.2 mg/dl) than those not treated (6.6 mg/dl). 12/46 calves were positive for M. hemolytica titers; no correlation between titers and serum protein levels was observed. Bovine coronavirus was present in calves between 1 and 6 weeks of age. BRSV was present only in calves at 11 weeks of age despite previous MLV intranasal vaccinations. Mannheimia hemolytica emerged in calves beginning at 3 weeks of age and peaked at 6 weeks. Pasteurella multocida was present in calves less than 1 week of age and at low levels throughout the sampling period. Histophilus somni was present in calves less than 1 week of age and in high levels throughout the sampling period, with a peak at 6 weeks of age. Mycoplasma spp. was not found in any samples. Relatively few calves were treated for respiratory disease this calving season. Results indicate overall good passive transfer in these calves, which likely preserved health in the face of documented colonization with respiratory pathogens. There was not sufficient evidence to implement changes in the vaccine program in this herd.

Introduction

Respiratory disease in pre-weaned beef calves has been a source of increasing attention in recent years. At the same time, calving in confinement has increased in popularity among operators in the Northern Plains, bringing with it increased opportunity for respiratory pathogens to spread among calves. A northeastern South Dakota 300-head cow-calf operation calving in confinement had documented pre-weaning pneumonia for the past several years, and sought to characterize passive transfer and patterns of respiratory pathogen colonization in their calves during the 2019 calving season.

Experimental Procedures

Calves studied came from 2 subsets of cows in the operation, heifers (n = 43) and purchased 3-year olds (n = 29); calves were born during February, 2019. Dams were vaccinated prior to calving with *Clostridium perfringens* Type A bacterin-toxoid (Sept.-Oct. 2018; Elanco Animal Health), *C. perfringens* Type C/*E. coli*/Rotavirus/Coronavirus killed virus/bacterin-toxoid (ScourGuard 4KC®, Zoetis), *Mannheimia hemolytica* bacterin-toxoid (OneShot®, Zoetis), and

BVD/IBR/BRSV/PI-3 chemically inactivated vaccine (CattleMaster 5®; 6 and 10 weeks pre-calving for heifers, 6 weeks pre-calving for cows). Calves were given an intranasal IBR/BRSV/PI-3 vaccine (InForce 3, Zoetis) at birth and 4 weeks of age, intranasal bovine coronavirus vaccine (Bovilis Coronavirus, Merck Animal Health) at birth, a combination *M. hemolytica* bacterin-toxoid/BVD viral vaccine (OneShot/BVD, Zoetis) and a 7-way Clostridial/*Histophilus somni* bacterin-toxoid (Vison 7/Somnus, Merck Animal Health) at 4 weeks of age. Calves also received an *E. coli*/rotavirus/coronavirus oral antibody product (First Defense Tri-Shield, Immucell) at birth, but no other colostrum supplements.

For the passive transfer study, serum was obtained via jugular venipuncture from 36 calves at 2-7 days of age (18 from each dam group) over 4 weekly visits. An additional 10 calves from the main herd were sampled in March 2019, separate from these 2 dam groups. Total protein was determined using refractometry. Calves with serum proteins > 5.5 mg/dl were deemed to have adequate passive transfer. *M. hemolytica* titers were determined using serum microagglutination (Texas A&M Veterinary Medical Diagnostic Laboratory, Amarillo). Titers > 1:2048 were considered positive. Descriptive statistics were compiled using standard spreadsheet software (Microsoft Excel).

For the respiratory pathogen study, deep nasal swabs from a set cohort of 5 calves from heifers, and a cohort of 5 calves from 3-year-olds) were obtained weekly from 0-7 weeks of age, then again at 12 and 18 weeks of age. In addition, a single sample was taken once from a separate group 20 calves aged 0-7 days. Swabs were placed into individual viral transport media vials and transported to the laboratory (South Dakota Animal Research and Diagnostic Laboratory, Brookings), where samples from calves within a cohort were pooled into a single sample per visit. The presence and relative abundance of BRSV, Bovine Coronavirus, *M. hemolytica*, *H. somni*, *P. multocida*, and *Mycoplasma spp.* were determined using real-time PCR. Ct levels < 40 were considered positive.

Results and Discussion

Calf health throughout the study period was better than in previous years, with 11/72 calves given treatments for undifferentiated fever; no deaths due to respiratory disease were noted. Average serum protein levels among sampled calves was 6.5 mg/dl (range 4.9-8.1), with only 6 of 46 calves below the 5.5 mg/dl threshold. Levels were similar between calves from heifers (6.3 mg/dl, n = 18) and those from 3-year-olds (6.5 mg/dl, n = 18). Within these 2 groups, 22 calves overall were treated for any illness during the study period; not all of them were sampled for serum protein, however. Treated calves had lower serum protein levels (6.2 mg/dl, n = 9) compared with non-treated calves (6.6 mg/dl, n = 37).

Twelve of the 36 calves were considered positive for *M. hemolytica* antibodies (> 1:2048). Positive calves had similar overall total protein levels (average = 6.4 mg/dl, n = 12) compared to negative calves (average 6.4 mg/dl, n = 24). Six of the 9 treated calves in this sample were negative for *M. hemolytica* antibodies, while 3/9 were positive.

Overall, the management of this herd resulted in good levels of passive transfer, as measured against the standard of 5.5 mg/dl serum protein. Since the herd did not have a group of non-

vaccinated cows for comparison, it was not possible to determine whether the pre-calving vaccine program influenced this. Providing calves a supplemental antibody product at birth also likely influenced these levels; again, since no comparison group was available, the effects of this treatment were not discernable.

Viral respiratory pathogens (BRSV and Bovine Coronavirus) were sporadically identified in each cohort of sampled calves, despite recent intranasal vaccinations with live attenuated versions of these pathogens. For coronavirus, the heifers' calves cohort was positive at 1 and 3 weeks of age, while the 3-year-olds' cohort was positive only at 3 and 5 weeks of age. Only 2 samples were positive for BRSV: both cohorts at 11 weeks of age, following an intranasal vaccination. Bacterial respiratory pathogens were more commonly identified. For *M. hemolytica*, the heifer cohort was positive at 2, 3, 5, 6, 11, and 17 weeks of age; the 3-year old cohort was positive only at the 2 later sampling points (11 and 17 weeks of age). Overall, *M. hemolytica* levels were highest in calves at 5 weeks of age.

Pasteurella multocida was the most consistent pathogen found in either cohort. Samples were positive (although at low levels: Ct 27-36) at each sampling point, except for the heifer cohort at 17 weeks of age. Minor peaks were noted at the 1 and 5 week sampling points. *Histophilus somni* levels were relatively high and consistent in both cohorts. Both cohorts were negative at the 1 week sampling point, but positive at each point thereafter, except for the heifer cohort at 2 weeks of age. Levels peaked at the 5 and 6 week sampling points, and were lower as the calves aged.

Mycoplasma spp. was not found in any of the samples. Too few treated calves were sampled for respiratory pathogens to determine whether one organism predominated in treated vs. untreated calves.

Perhaps the most interesting finding with the respiratory pathogen portion of the study was the lack of positive results for bovine coronavirus and BRSV in the face of recent intranasal vaccination with products containing live versions of these agents. Investigators did not test calves for IBR due since it was supposed the samples would be positive due to vaccine use. Perhaps vaccine replication in the nasal passages was at too low a level to be detected, or the calves' immune system had cleared the vaccine virus by the time of sampling. Regardless, there was no indication that viral respiratory pathogens played a role in calf illness in this herd.

Bacterial pathogens, on the other hand, were present in calves beginning at a very young age, and mostly persisted throughout the study period. Levels peaked at around 5-6 weeks of age in this herd. Since respiratory disease results from bacteria in the nasal passages finding their way to the lung tissue, the more bacteria present in the nasal passages, the higher the risk of pneumonia. For this herd, efforts to identify and treat calves with respiratory disease should especially focus on this age group.

The herd experienced a much lower rate of respiratory illness in calves during this calving season compared to past years, even in the face of challenging weather conditions that meant calves stayed in confinement more. This may be due to the pre-calving vaccine program which

included respiratory vaccines, to the antibody product administered at birth, or to a myriad of other interventions with the cow herd, including nutritional and mineral management.

Since the study herd was a commercial operation, non-treated control groups were not available to help in assessing the effect of specific interventions. The work here revealed a method to assess the adequacy of passive transfer and helped assure the operator that efforts to provide high-quality and –quantity colostrum were sufficient in these calves. It also demonstrated that longitudinal sampling of young calves can help identify pertinent respiratory pathogens, as well as the optimal time to observe calves for respiratory disease.

Implications

- Bacterial respiratory pathogens were present in the nasal passages of beef calves in confinement as early as 1 week of age, and throughout a 17-week evaluation period.
- Despite the presence of pathogens in calf nasal passages, individual calves' immune systems sufficiently prevented them from causing pneumonia. At least part of this can be ascribed to good passive transfer of colostral antibodies in the herd overall.
- Viral respiratory pathogens were present rarely and sporadically in nasal passages, and were not found in calves recently vaccinated with corresponding live intranasal vaccines.
- Measuring the levels of Mannheimia hemolytica in neonatal calves did not prove useful in predicting pneumonia protection in individual calves.
- Future studies should incorporate control groups in order to better evaluate the effect of interventions.

Acknowledgements

Research supported through the SDSU Veterinary Extension Field Investigation Fund and Zoetis Animal Health.