SDSU Extension

livestock

APRIL 2018

SOUTH DAKOTA STATE UNIVERSITY®
VETERINARY & BIOMEDICAL SCIENCES DEPARTMENT

Pre-weaning Pneumonia in a South Dakota Beef Herd: A Persistent Problem, Suddenly Gone

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This case report describes a southeastern South Dakota cow-calf herd's experiences with pre-weaning pneumonia. Unlike many beef herds that experience pneumonia in calves on pasture, this herd's problems were consistent year after year: widespread calf illness was documented in each of 6 consecutive summers. Anecdotally at least, the occurrence of pre-weaning pneumonia in beef herds is more likely to be sporadic and unpredictable from year to year. This herd's persistent problems were followed by a year in which, after a change in calf vaccination protocol (informed by herd diagnostics), very little pre-weaning pneumonia was observed.

Herd Characteristics and History

This 90-cow herd is located in southeastern South Dakota. About half the cows are commercial Black Angus, while the other half is comprised of cows of various breeds that produce show calves. Both types of cows are run together as 1 management unit. The herd is closed except for yearly bull purchases.

Calving in this herd takes place in February for heifers, and March and April for the cows. As such, the most active part of the breeding season occurs during mid-June. Artificial insemination (AI) is employed for cows producing show calves, as well as for some of the commercial cows. Bulls are used for the rest of the herd, and for clean-up following AI.

During the AI period, cows were moved among 3 pastures. Some of the cows from each of 2 pastures were brought to the third location for AI. Any cows in the third pasture that weren't to be bred were moved to the other 2 pastures at that time. This allowed ample opportunity for sub-populations of calves to co-mingle with each other. Cows were bred off heat detection utilizing a synchronization program. These cow movements took place over a 2 week AI period.

In 2015, the lease was lost on 1 of the 3 pastures; breeding subsequently took place utilizing the 2 remaining pastures, with cows shuffled between the two during the AI period. In 2016, the process of switching cows back and forth between pastures for breeding changed such that all cows were moved only once: cows to be AI'ed from the second pasture were moved to the AI pasture, and cows that weren't to be AI'ed were moved from the AI pasture to the second pasture. These movements all took place on or about July 16.

Calves on pasture received creep feed beginning in the late summer. Creep feed was medicated with a chlortetracycline/sulfamethazine combination[a]; this medication was discontinued beginning with the summer of 2017.

Table 1. Overview of calf vaccination practices, South Dakota cow-calf herd, 2011-15

Vaccine	2011	2012	2013		2014		2015
	Mid-June	Mid-June	Late May	Early July	Early June	Mid-July	Early July
Intranasal MLV IBR-BRSV-PI3[b]	x	x	x		x		x
7-way Clostridial + H. somni[c]	x	x	x		x		x
Pinkeye[d]	x	x	x		x		x
Parenteral MLV IBR-BRSV-PI3-BVDV/Mannheimia hemolytica toxoid[e]				x		x	x

Previous Herd Vaccination Practices

Calves in this herd were vaccinated at least once each year toward the beginning of the grazing season. (Table 1). Bull calves were band castrated and fly tags, pour-on external parasite control, and injectable dewormers were also administered to calves during these dates.

In 2016, the herd owners embarked upon a new calf vaccination protocol, in an attempt to head off problems with pre-weaning pneumonia. This schedule consisted of:

May 18:	• MLV Rotavirus/Coronavirus vaccine[g] given intranasally
June 2:	• Intranasal MLV IBR-BRSV-PI3[b] • Pinkeye[d]
June 29:	• Parenteral MLV IBR-BRSV-PI3-BVDV/ Mannheimia hemolytica toxoid combination[e] • 7-way Clostridial + H. somni[c]

In addition to this vaccine change, the operators instituted the practice of tube-feeding a colostrum supplement[e] to any calf requiring assistance being delivered. Subsequent monitoring of serum proteins confirmed that passive transfer (adequate absorption of antibodies from colostrum) was occurring in these, as well as untreated, calves. Initially, these changes seemed to help during the 2016 grazing season, as calves subjectively appeared healthier and more active, up until they broke with pneumonia on July 19.

Calf Illnesses

In each of the years 2011-2016, calves broke with clinical signs of illness in mid-June through early August. The outbreaks exhibited high morbidity (illness rates) but low mortality (death rates). Calves showed signs of respiratory involvement and lethargy, coinciding with fevers in the 104-106°F range. Herd owners were prompt with treatment, typically consisting of florfenicol/flunixin meglumine[h] or tildipirosin[i], but tulathromycin[j] or enrofloxacin[k] were also used occasionally as well. Treated calves showed a partial response to treatment, becoming visibly more active, but with lingering respiratory signs and a setback in body condition. Treatments typically began as individual calf treatments as the outbreak commenced, but this approach proceeded to metaphylaxis/whole group treatment after 10-20% of the calves had been pulled for treatment.

Antibiotic sales records were used to determine the approximate onset of pneumonia in the herd, as the herd owners typically purchased antibiotics only as they were needed, and exclusively from 1 veterinary clinic. Dates of initial onset of calf illness each year are as follows:

- 2011: August 5
- 2012: August 7
- 2013: July 10
- 2014: June 14
- 2015: July 18
- 2016: July 19

Dates that mass treatments took place each year were approximated in a similar manner as above, and included:

- 2011: August 31-September 2
- 2012: August 28
- 2013: July 22
- 2014: August 14 + September 2
- 2015: July 22-25 + August 7
- 2016: July 22

Most calves were 4-5 months of age at the time of these treatments. All calves in the herd were treated during each of these dates, regardless of clinical signs or rectal temperatures. Rectal temperatures were not obtained from every treated calf, but of those that were checked, 83% had morning temperatures over 104°F. Only a handful of calves (2-5 head) in any given year were treated for any illness before these widespread outbreaks.

In all years, the incidence of illness was not noticeably different between show calves and commercial calves, however, in 2016, calves from the show calf portion of the herd broke earlier than the commercial calves.

As previously mentioned, calf illness tended to be high morbidity and low mortality. Mortalities were recorded in 2014 (1 untreated calf in September) and 2015 (2 calves in July: 1 treated, 1 untreated). No written records exist for other mortalities, however, anecdotally 1 calf would typically be found dead in each of the other years prior to 2017.

Herd Diagnostics

Diagnostics were performed on 1 of the dead calves in July, 2015. This calf exhibited moderate to severe pneumonia (specifically, lobular bronchointerstitial pneumonia with microabscesses and septal edema).

Pasteurella multocida and *Mannheimia hemolytica* were cultured from lung tissue. Neither germ isolate showed patterns of resistance to commonly used antibiotics. Evidence of viral infection was not found in this calf, with PCR (polymerase chain reaction) tests negative for BRSV and bovine coronavirus, and FA tests negative for BVDV, IBRV, RSV, and bovine coronavirus. Histopathology (microscopic tissue examination) indicated the possible involvement of *Mycoplasma spp.*; culture for *Mycoplasma* was negative, however.

In late July 2016, nasal swabs and transtracheal wash (TTW – a method that surgically introduces a sampling tube into the windpipe, bypassing the nasal passages to obtain samples directly from the lower lung) samples were taken from live, sick calves. PCR testing of 1 of the TTW samples revealed the presence of bovine coronavirus at a low Ct level (24.8). No other viral or bacterial pathogens were identified in the TTW samples. The nasal swabs submitted were found to be contaminated.

Summer of 2017: Herd Interventions and Outcome

In 2017, the herd transitioned to a new calf vaccination program, consisting of:

May 22:
- Intranasal bovine coronavirus vaccine[l]
- Intranasal MLV IBR-BRSV-PI3[b]
- 7-way Clostridial + H. somni[c]
- Pinkeye[d]

June 26:
- Intranasal bovine coronavirus vaccine[l]
- Parenteral MLV IBR-BRSV-PI3-BVDV/ Mannheimia hemolytica toxoid combination[e]
- Pinkeye[d]

Similar to previous years, calves were band castrated and fitted with fly tags during the May treatment. Dectomax injectable was administered in June. Cow and calf movements for breeding occurred in the same manner as in 2016.

In the summer of 2017, the incidence of calf pneumonia was markedly decreased compared to previous years. In all, the herd owners identified 5 calves that needed individual treatment in mid-summer, and there was no progression to the herdwide outbreak that in previous years forced the producers to mass-treat the calves on pasture.

Discussion

This case report documents a consistent pattern of pre-weaning calf illness in a commercial beef/show calf herd in southeastern South Dakota, followed by a year in which very little illness was noted in the calves.

Pre-weaning pneumonia in beef calves has proven to be a challenging and inconsistent feature of many, but not all, cow-calf herds during the summer months. Anecdotally, at least, most of these problems feature high morbidity (illness rates) and low mortality (death rates). As such, there usually is a very limited amount of diagnostic data from dead calves available to veterinarians and cattle producers to guide their prevention and treatment practices. In this herd, necropsy of 1 of the few mortalities provided largely unrewarding information. Bacterial pneumonia was confirmed, which was valuable in confirming the cause of the clinical signs noted in the ill calves, but yielded little information as to inciting causes.

Sampling of live but sick calves undergoing these outbreaks is one possible approach to help determine the germs involved in pre-weaning beef calf pneumonia. Nasal swabs are frequently submitted to diagnostic labs, yet the germs found in the nasal passages are not always the same as the bacteria and especially viruses in the lower lung affected by pneumonia.[1] Furthermore, as in this case, they are subject to contamination issues. Samplers may minimize sample contamination by wiping out nostrils with single-use disposable paper towels prior to sampling, and by wearing a new pair of disposable exam gloves in between sampled calves.[3] Deep nasopharyngeal swabs (obtained through the nose, but extending deeper into the back of the throat) perhaps better reflect the germ populations in the lower respiratory tract, yet are technically more difficult to obtain.

Obtaining transtracheal washes, and alternatively, bronchoalveolar lavage (a method of obtaining samples from the lower lungs by introducing a tube through the nasal passages deep into the lower airways) samples from calves on pasture, is even more technically challenging, yet these samples may give results that more accurately indicate the germs involved in pneumonia cases. In particular, in calves suffering from pneumonia, bovine coronavirus may be a more common finding in the upper respiratory tract than

in the lower respiratory tract.[1] In this case, it was the identification of bovine coronavirus in relatively large amounts in transtracheal washes – along with the absence of other pathogens – that helped guide preventive practices for the next year's calf crop.

The role of bovine coronavirus in pneumonia is still being investigated. The finding, as in this case, of coronavirus in the absence of other pathogens in pre-weaning beef calf pneumonia cases, has driven veterinarians to seek vaccine protocols addressing it. As in this herd (2016), the use of an existing modified live coronavirus/rotavirus vaccine[g] (labeled for the prevention of neonatal diarrhea) is something that has been attempted in the past, with varying results in affected herds. The recent approval of an intranasal bovine coronavirus vaccine[l] (again, labeled for the prevention of diarrhea) has also encouraged veterinarians to attempt its extralabel use in pneumonia prevention for pre-weaned calves.

Several management-based risk factors potentially important to the development of pre-weaned calf pneumonia in beef herds have been identified.[2] These include longer calving seasons, larger herds, heat synchronization programs (presumably due to gathering and co-mingling of different calf groups), creep feeding, importing new calves, and intensive grazing programs, among many others. While some of these risk factors were present in this herd (i.e., synchronization programs and creep feeding), others were not. More importantly, none of these herd management factors significantly changed in the herd between the 2016 pasture season, with a high incidence of calf pneumonia, and the 2017 season, in which very little calf pneumonia was identified.

One management factor that changed between years (in addition to the discontinuation of medication in creep feed) was the implementation of an intranasal bovine coronavirus vaccine[l] at the time of pasture turnout. This vaccine differed from the coronavirus vaccine the herd used in 2016[g]; in addition, calves received two doses of the vaccine in 2017, while calves in 2016 received one dose. While this vaccine has not been evaluated or approved for prevention of pneumonia in which bovine coronavirus is involved, it may hold some promise as an early intervention that could stimulate a calf's immunity against this potential pathogen. The finding of bovine coronavirus in sick calves in the absence of other respiratory pathogens in this herd provided the herd veterinarian with a piece of evidence that could be used when considering the application of this vaccine in this herd.

Take-home Points for Cattle Producers

- Pre-weaning pneumonia in beef cattle herds is a challenging, often inconsistent problem.
- Many risk factors for pre-weaning pneumonia have been identified, yet none of them are consistent across all herds with the problem. It's likely that a set of risk factors important for the development of pre-weaning in one herd can be very different for another herd.
- As demonstrated by this case, a solid vaccination program against pre-weaning pneumonia germs does not always prevent problems from occurring. Likewise, judging the success of a change in a vaccine program should take place over more than one season.
- Enlisting the assistance of your herd veterinarian to form a diagnostic plan, and to evaluate risk factors for pre-weaning pneumonia is the first step to take when this problem is identified in a herd.

Take-home Points for Veterinarians

- Many risk factors for pre-weaning pneumonia have been identified, and likely are different for different herds.
- Vaccination programs should focus on stimulating immunity against likely pneumonia pathogens prior to the onset of pneumonia in a herd.
- Nasal swabs, while technically easy to obtain, may not yield results representative of pathogens in the lower lungs causing pneumonia. Transtracheal washes or bronchoalveolar lavage samples may better represent lung pathogens.
- Contamination of nasal swabs is common, and may be reduced by wiping out nostrils prior to sampling, and by using disposable gloves between animals.

Footnotes

[a]AS700®, Zoetis, Parsippany, NJ

[b]InForce 3®, Zoetis, Parsippany, NJ

[c]Vision 7/Somnus®, Merck Animal Health, Madison, NJ

[d]I-Site XP®, AgriLabs, St. Joseph, MO

[e]Bovishield Gold/One Shot®, Zoetis, Parsippany, NJ

[f]Bovine IgG Calf's Choice Total Gold®, Saskatoon Colostrum Co., Saskatoon, SK

[g]Calf Guard®, Zoetis, Parsippany, NY

[h]Resflor Gold®, Merck Animal Health, Madison, NJ

[i]Zuprevo®, Merck Animal Health, Madison, NJ

[j]Draxxin®, Zoetis, Parsippany, NY

[k]Baytril®, Bayer HealthCare, Shawnee Mission, KS

[l]Bovilis®, Merck Animal Health, Madison, NJ

Abbreviations

AI = artificial insemination

MLV = modified line virus

IBR = infectious bovine rhinotracheitis

BRVS = bovine respiratory syncytial virus

PI3 = parainfluenza-3

BVDV = bovine viral diarrhea virus

TTW = transtracheal wash

References

[1]Doyle D, Credille B, Lehenbauer T, et al. (2017). Agreement among 4 sampling methods to identify respiratory pathogens in dairy calves with acute bovine respiratory disease. J Vet Intern Med, 31:954-959.

[2]Woolums A, Berghaus R, Smith D, et al. (2018). Case-control study to determine herd-level risk factors for bovine respiratory disease in nursing beef calves on cow-calf operations. J Am Vet Med Assn, 252:989-994 [accepted for publication].

[3]A. Woolums, personal communication.

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Publication: 02-2001-2018