Fatal Non-Responsive Diarrhea in Beef Calves 6 to 8 Weeks of Age

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This is a case presentation of an epidemic of fatal, non-responsive diarrhea in 6 to 8-week old beef calves on a Saskatchewan cow-calf farm in May, 1991.

Members of the audience are asked to read and consider the case history, the clinical descriptions of the affected calves, and answer the questions at the end of Part One. After the questions and differential diagnoses have been discussed, the diagnostic laboratory results will be given and discussed in Part Two.

Part One

Complaint

Fatal non-responsive diarrhea in 6 to 8-week old beef calves in a 60 head cow-calf herd.

The owner called the Large Animal Clinic of the Western College of Veterinary Medicine (WCVM) on May 22, 1991, and complained about a high incidence of fatal non-responsive diarrhea in his 2-month old Charolais crossbred beef calves. By this date, 50 of the 60 cows in the herd had calved. According to the owner, the first abnormality noted in the calves was diarrhea without any other signs. In the early stages of the disease, the calves were still sucking their dams normally and could not be caught easily for treatment. However, after a few days of diarrhea the calves would become depressed, their noses appeared "scabbed", they seemed "feverish" and in spite of therapy they died several days later. About 40% of the calves had developed diarrhea at 6 to 8 weeks of age, and six calves had died by the time we were consulted. The owner emphasized that the calves did not have diarrhea until they were several weeks of age.

The local veterinarian had not examined the calves and had not visited the farm during this epidemic. However, he had discussed the problem with the owner and had prescribed intramuscular trimethoprim-sulfadoxine, oral sulfamethazine boluses, and oral electrolyte solutions for the affected calves. The veterinarian had also recommended that if the calves did not respond to therapy, the owner should consult with our large animal clinic for further advice. On May 22, the owner wanted to bring some affected calves to our clinic in an attempt to arrive at a diagnosis and for advice on treatment.

History and Herd Management

The history which is described here was taken from the owner on his arrival in our clinic. The herd consisted of a group of 30 Charolais crossbred first-calf and second-calf heifers and cows, and a group of 30 mixed age, crossbred cows. The two groups were maintained separately throughout the year.

During the winter months, both groups of cows were fed a mixture of sweet clover-alfalfa-rye hay and a grain mixture comprised of approximately two-thirds ground oats and one-third ground barley to which a salt mineral mixture, based on a 3:1 ratio of calcium and phosphorus with trace minerals and vitamins A, D, and E, had been added at a rate of 7 lbs of mineral premix per 5800 lbs of grain mixture (0.12kg/100kg) (Table 1). The mature cows were fed about 6 lbs (2.75kg)/head/day of the grain mixture and the young cows received slightly more. The source of water was from an artesian well which had been used uneventfully for many years. The calving period started in the first week of March and continued through until the first part of May. Only minor, routine calving complications occurred during the calving period. However, this year, four calves, two from each group of cows, were born weak but unassisted and died within a few days after birth. No diagnosis was obtained and the owner did not have an opinion about the causes of death.

In the first week of May, the young cows and their calves were placed in a 40 acre pasture adjacent to the calving corrals. During the next few days, the owner noticed that several calves appeared slightly dull, and some calves had fecal staining of the perineal region. The owner treated the calves for diarrhea with oral neomycin and sulfamethazine boluses and injectable trimethoprim-sulfadoxine or oxytetracycline. Commercially available electrolyte solutions were sometimes given orally at the rate of 1.0 to 1.5 liters once or twice a day. The diarrhea continued and within a few days the calves became more

Table 1. Composition of Co-op 3:1 Mineral Mixture

Component	Concentration
Selenium	30 mg/kg
Calcium	24%
Phosphorus	8%
Sodium	4%
(Equivalent to 10% salt)	
Zinc	6000 mg/kg
Iodine	275 mg/kg
Iron	5000 mg/kg
Magnesium	6000 mg/kg
Copper	3300 mg/kg
Cobalt	80 mg/kg
Fluoride	Maximum conc. 3000 mg /kg
Vitamin A	500,000 I.U./kg
Vitamin D_3	50,000 I.U./kg
Vitamin E	500 I.U./kg

Purchased winter 1990/91

Recommended inclusion rate: 1 kg/100 kg total mix of grain or 100 g of mineral mixture/mature cow/day

Actually included at 7 pounds to 5800 lbs grain (0.12 kg/100 kg total grain mixture)

depressed, dehydrated, weak and died. Six calves with this history died before we were consulted about the problem. As of May 22, 10 calves out of 50 had died (4 were born weak and died within 24 hours after birth, and 6 had diarrhea at 6 to 8 weeks of age and died).

Clinical Findings

On May 22, 1991, one dead calf and two live diarrheic calves were submitted to our clinic for treatment and an attempt to determine the etiology of the diarrhea and the high case fatality rate. The dead calf, No. 7, had been diarrheic for several days and had not responded to treatment. It was submitted to the diagnostic pathology laboratory. The gross pathologic findings included poor body condition, dehydration, and absence of perinephric and mesenteric fat. The small and large intestines contained a large quantity of green-brown liquid material. A gross pathologic diagnosis of dehydration and diarrhea of unspecified etiology was made.

The two live diarrheic calves (No. 1 and No. 24) were admitted to the clinic for treatment and diagnostic work.

Calf No. 1, from a second-calf cow, was 8 weeks of age, weighed about 70 kg, and had been diarrheic for 4 days. It had been treated for the last few days with sulfamethazine boluses, injectable oxytetracycline, and oral electrolyte solution but had not responded favourably. It was weak, 10-12% dehydrated, had lost considerable body condition, and was depressed but could still stand and walk slowly. The temperature, heart rate and respirations were within normal ranges. It was passing foul-smelling liquid brown feces. The calf was treated for dehydration and metabolic acidosis using intensive intravenous fluid and electrolyte therapy containing a mixture of isotonic sodium bicarbonate and saline.

Calf No. 24, from a mature cow, was 8 weeks of age, weighed about 65 kg, and had been diarrheic for 7 days. It had been treated with oral antibiotics and oral electrolyte solutions for the last 7 days. It was depressed, dehydrated, diarrheic (green, malodorous feces), and in lateral recumbency. The temperature, heart rate and respirations were within the normal ranges. This calf was also placed on intensive fluid and electrolyte therapy for correction of metabolic acidosis and dehydration.

Based on the initial examination of the calves, we advised the owner that the prognosis for the two calves was fair and that it would require about three days of intensive therapy to adequately assess the response to treatment.

The owner reported that several more calves in the herd were diarrheic and he requested advice on treatment. He was advised to closely examine the calves several times daily, to identify diarrheic calves as early as possible, and to treat them with oral electrolyte solution. The preparation and administration of oral electrolytes solutions for diarrheic calves was reviewed with the owner. He was advised that diarrheic calves with clinical signs of severe dehydration should be taken to the local veterinary clinic for intensive intravenous fluid therapy.

Calf No. 1 was treated with intensive intravenous fluid therapy for three days, fed cow's whole milk in small amounts (1.5 liters) three times daily, given intramuscular ceftiofur-sodium (Excenel) daily, and provided with nursing care. It began sucking milk and electrolytes from a nipple bottle but did not regain enough strength to stand on its own. When assisted, it would stand for a few minutes, begin to tremble, and then lie down in sternal recumbency. The diarrhea continued for three days. The temperature, heart rate and respirations remained within the normal ranges.

Calf No. 24 was placed on intravenous fluid therapy and given ceftiofur-sodium intramuscularly. The response to the fluid therapy was poor. The diarrhea continued, the calf remained weak, and it was euthanized on May 23 and submitted for necropsy. The gross pathologic findings included mycotic rumenitis, hepatic and reticular infarcts, and chronic colitis.

As a result of the pathologic finding of mycotic rumenitis, the owner was advised not to use oral antibiotics in the diarrheic calves for more than two to three days. He was also advised to increase the total amount of oral electrolyte solutions to the large diarrheic calves to 2 liters three times daily because it was felt that he may not have been using adequate quantities of fluids for the large calves.

On May 25, 1991, two additional diarrheic calves, No. 45 & No. 21 were admitted to our clinic. The owner reported that the problem seemed to be getting worse. More calves were affected, they were not responding to therapy,

and he wondered if all of his calves would eventually become ill and die.

Calf No. 45 was a 6-week old male from a second-calf cow and weighed about 60 kg. The calf had been diarrheic for several days, treated with the same drugs as the other calves, but had not responded favourably. It was severely dehydrated, diarrheic, hypothermic (< 35°C), and recumbent. Because of the advanced condition of this calf and the poor prognosis, blood samples for clinical pathology were taken, and it was euthanized and sent to necropsy.

Calf No. 21 was a 6-week old male from a mature cow and weighed about 65 kg. It had been diarrheic for one week, had not responded to therapy, and had lost considerable body condition. It was in sternal recumbency, weak, and only able to stand with assistance. It was also depressed, 8% dehydrated, and passed profuse, green, foul-smelling feces. Blood samples for clinical pathology were taken and the calf was placed on intensive intravenous fluid and electrolyte therapy.

This is the end of the description of the history and the clinical findings of the affected calves.

Are there any questions about the history or clinical findings?

What is the case definition?

How would you attempt to make a definitive etiological diagnosis?

What are your differential diagnoses in order of probability from highest to lowest?

How would you have treated the affected calves and how would you manage the herd problem?

Part Two

Pathology and Clinical Pathology

At necropsy, on May 25, 1991, calf No. 45 was mildly dehydrated and the tail and perineum were stained with brown, soft fecal material. A focal area of necrosis, 1 cm in diameter, was present in the proximal esophagus. There were small, multifocal areas of atelectasis scattered throughout both cranial lung lobes.There were multiple, irregular, small pale areas within the left ventricular wall. Two small hair balls were present in the rumen. A small amount of greenish fluid was present in the small and large intestines. A diagnosis of acute, focal esophageal necrosis and subacute, multifocal myocardial necrosis was made. The myocardial lesions suggested that enzootic nutritional muscular dystrophy was an important finding and could have explained the weakness and recumbency which was previously attributed to the effects of the dehydration and acidosis caused by the diarrhea.

On the afternoon of May 25, serum previously stored from calf Nos. 45 and 24 were analyzed for creatine phosphokinase (CPK). The results were > 40,000 u/L and 16,744 u/L, respectively which suggested a diagnosis of nutritional muscular dystrophy commonly associated with a deficiency of vitamin E and/or selenium. Following these findings, the owner was advised to treat all calves in the herd with a commercial preparation of vitamin E and selenium intramuscularly which he did on May 26.

Calf No. 21 was also treated with vitamin E and selenium after admission and given intensive fluid therapy, and nursing care including frequent feedings of small quantities of cow's whole milk. In spite of intensive therapy it died 4 days later. Pathologic findings included widespread acute skeletal and myocardial degeneration and severe myoglobinemic nephrosis. There was no gross pathologic evidence of enteropathy but the large intestines contained liquid brown material and excessive quantities of mucous.

Calf No. 1 was treated in the clinic for several days. Treatment consisted of intensive fluid therapy, parenteral antibiotics, milk fed twice daily, nursing care, and parenteral vitamin E and selenium beginning on May 25. The calf remained recumbent and died on June 1. Necropsy revealed widespread areas of pale skeletal muscle, an enlarged heart due to dilation of the right ventricle, focal esophagitis, focal pneumonia, fluid filled small and large intestines and excessive quantities of mucous in the colon. The final pathologic diagnosis was subacute rhabdomyolysis, renal tubular nephrosis, pulmonary embolism, focal pneumonia, and focal esophagitis. Serum and tissue samples from the calves already examined in the clinic were submitted for analysis of vitamin E, selenium and serum muscle enzyme levels. Thus, three of the calves submitted to the clinic had severe skeletal and/or cardiac muscle necrosis which may have been a major cause of the weakness and recumbency. Analysis of tissue and plasma vitamin E levels from these three calves revealed a marked deficiency of vitamin E. The plasma levels of vitamin E which are considered to be deficient are not well documented. For this study, 3.6umol/L was considered as the level below which a deficiency exists. One reference uses 2.0 mg/L or 4.75umol/L(1). The tissue selenium levels were within adequate levels. The results are summarized in Table 2.

Investigation of the Herd

On May 26, the owner was advised by us that the herd should be investigated in an attempt to determine the factors associated with the suspected vitamin E and selenium deficiency, and to attempt to explain the possible causes of the diarrhea.

The farm was visited on May 29, 1991. The objective was to do a field investigation of the occurrence of the diarrhea and the nutritional muscular dystrophy. Although exact birth dates were not available for all of the calves, it appears that 80 to 90% of the calves were born in the first

Table 2. Necropsy and Diagnostic Test Results from Calves Submitted to the WCVM

Calf ID	Date Died	Cause of Death	Plasma Vitamin E (umol/L)	Plasma Selenium (ppm)	Serum CPK (U/L)	Serum AST (U/L)
7	May 22	enteritis, dehydration, nephrosis	-		-	-
1	June 1	white muscle disease	0.89	0.134	>40,000a	6116b
24	May 23	mycotic, rumenitis, chronic colitis	-	-	16744[a]	311[b]
45	May 25	white muscle disease, chronic enteritis, nephrosis	-	-	-	-
21	May 29	white muscle disease, nephrosis	1.37	0.198	>40000[a]	1893[b]

[a]increased; (normal laboratory values 0 - 350)
[b]increased (normal laboratory values 46 - 118)
- not done
See Table 3 for laboratory values of vitamin E which are considered deficient, marginal, and adequate; and laboratory values of selenium which are considered adequate.

six weeks of the calving season.

The overall calf mortality rate in this herd was 30% (15/50). The calf population mortality rate attributable to the epidemic of non-responsive diarrhea was 22% (11/50). The actual morbidity, treatment and case fatality rates could not be calculated because of the poorly defined nature of the "sick calves" and the fact that the owner did not keep treatment records. The owner estimated that 40% (20 calves) had developed diarrhea at about 2 months of age. In spite of therapy, 11 of these 20 calves died. The resulting case fatality rate is approximately 55%; however, it may actually have been higher than this because during the herd visit the owner did not identify any calves that had been successfully treated for the diarrhea.

Cattle from both groups of females calved in corrals with open front sheds for shelter. The corral in which the first and second calf heifers were maintained was small and the entire area was poorly drained. Drainage of the ground surface of the corral in which the mature cows calves was also less than ideal and the owner admitted that it was difficult to keep either of them well bedded.

At the time of the herd visit, the young cows and their calves were kept on a 40 acre pasture adjacent to the home farm. The pasture had a grove of trees at one end to provide shelter and, additionally, there were two old granaries available for the calves to seek shelter away from the cows. There was an old dump site on the pasture where materials from the farm had been piled and burned. It had not been used as a dump for several years and upon close inspection there was no evidence of any materials present that would be dangerous to the health of the cows or calves. The young cows were in good body condition (average body condition score of 3 on a scale of 1-5). Clinically, the cows and calves all appeared to be normal. Several calves had fecal staining of the perineal region, but they were bright, alert and responsive. No diarrhea was seen and none of the calves showed evidence of dehydration.

The older cows and their calves were in a corral at the home farm. This was the same corral that had been used for calving, but it had been expanded to allow access to an adjacent area. These cows were also in good body condition. The calves from these cows were examined individually and fecal and blood samples for further diagnostic testing were taken from all calves. In general, the calves were in good body condition and few abnormalities were found on physical examination. The only abnormal clinical findings were that some of the calves had liquid, foul-smelling, mucoid feces, with or without fecal staining of the pereneal region. None of the calves were clinically dehydrated or exhibited signs of depression. A few calves had dull, rough hair coats.

Both groups of cows were being fed a grain ration and poor quality grass hay until there was enough new pasture growth available to provide adequate levels of nutrition.

Unfortunately, the owner had just recently (within a day or two) used all of the grain and clover-alfalfa-rye hay supplies that he had formerly fed to the cows. As a result, no representative feed samples were available for analysis. The amount of mineral mix previously added to the ration was calculated to 0.12%, which is markedly below the manufacturer's recommended inclusion rate of 1.0%. The label of the mineral premix indicated that the supplement contained 30 mg/kg of selenium and 500 IU/kg of vitamin E (Table 1).

The plasma vitamin E and selenium levels were determined on all of the calves from the older cows (Table 3). Samples taken from unsupplemented calves during the farm visit revealed marginal or deficient levels of vitamin E and normal levels of selenium in all of the calves. The selenium levels in this herd were well above what are normally encountered in this area. The two calves which had been given parenteral vitamin E/selenium supplementation 4 days prior to sampling were found to have normal levels of both vitamin E and selenium. In the untreated calves, there was no correlation between the plasma vitamin E and selenium levels. Serum samples from three normal calves, three calves with abnormal feces and two calves that were currently receiving treatment by the owner were analyzed for serum creatine phosphokinase (CPK) and aspartate aminotransferase (AST) levels. Whole blood and serum from these same 8 calves were submitted for bovine viral diarrhea virus (BVDV) isolation and serology. Samples of feces from these 8 calves were cultured for bacterial enteropathogens, examined for oocysts and helminth ova, and examined for the presence of viral pathogens (rotavirus and coronavirus) using electron-microscopic tech-

Table 3 Plasma Vitamin E and Selenium Levels from Calves Belonging to the Older Cows, Herd Visit May 29, 1991

Calf No.	Clinical Status	Treatment Status	Plasma Vitamin E (umol/L)	Plasma Se (ppm)
17	normal	not treated	1.54	0.075
5	normal	not treated	5.19	0.118
16	normal	not treated	2.63	0.165
19	normal	not treated	2.67	0.171
51	normal	not treated	2.59	0.078
52	normal	not treated	1.82	0.074
36	normal	not treated	1.14	0.113
56	normal	not treated	4.42	0.102
28	abnormal	not treated	3.73	0.120
48	normal	not treated	3.81	0.113
13	normal	not treated	1.72	0.108
29	normal	not treated	2.85	0.108
6	normal	not treated	1.26	0.090
27	normal	not treated	2.23	0.158
43	normal	not treated	1.21	0.115
10	abnormal	not treated	0.95	0.180
11	abnormal	not treated	1.48	0.156
12	normal	not treated	2.72	0.194
26	abnormal	not treated	3.22	0.136
37	normal	not treated	2.00	0.111
25	normal	not treated	2.29	0.122
46	normal	not treated	2.76	0.124
20	normal	not treated	3.06	0.124
57	normal	not treated	4.50	0.144
58	normal	not treated	2.58	0.142
18	abnormal	treated	10.18	0.272
42	abnormal	treated	7.58	0.231

Clinical Status - abnormal calves had abnormal feces with or without other abnormal findings
Treatment Status - treated calves received parenteral vitamin E and selenium and oral electrolytes (see Table 2)
Plasma Vitamin E - Calves #17, 16, 19, 51, 52, 36, 13, 29, 6, 27, 43, 10, 11, 12, 26, 37, 25, 46, 20, and 58 were all deficient (< 3.6umol/L)
- calves #5, 56, 28, 48 and 57 were marginal (3.6-7.0umol/L)
- calves #18 and 42 were adequate (> 7.0umol/L)

Plasma Selenium - all values were adequate (> 0.07ppm);

Reference laboratory values for selenium (11) and vitamin E (1). The vitamin E value of 3.6umol/L is based on laboratory observations of the Diagnostic Laboratory of the Department of Veterinary Physiological Sciences, W.C.V.M.

niques. The results are summarized in Table 4.

Discussion

The occurrence of the diarrhea in calves at 2 months of age and their failure to respond to therapy suggested a severe viral enteropathy. The weakness and recumbency in the affected calves treated in our clinic was initally attributed to the effects of the prolonged diarrhea, partial starvation, dehydration and acidosis. However, the unexpected pathologic findings of enzootic nutritional muscular dystrophy and the increased levels of serum muscle enzymes suggested a diagnosis of enzootic muscular dystrophy usually associated with a dietary deficiency of vitamin E and/or selenium.

The cause of the diarrhea in the calves was not determined. The bovine virus diarrhea virus (BVDV) was considered as a possible causative agent but the virus was not demonstrated in the feces or tissues of affected calves or those sampled on the farm. Serology for the BVDV was inconclusive. Bovine coronavirus and cryptosporidia are also possible causative agents of diarrhea in calves over a few weeks of age. However, examination of fecal samples obtained from clinic cases, necropsy specimens, and from calves sampled during the herd visit did not identify any known enteric pathogens. A deficiency of selenium has been suggested as a cause of diarrhea, ill-thrift and mortality in beef calves from 1 to 6 weeks of age.[4,10] In a two-year study of 72 Hereford x Simmental cows, averaging 498 kg in body weight and 5.2 years of age, injections of the cows with selenium and vitamin E beginning 3 to 4 months prepartum and at 60-d intervals throughout the two-year period, and injection of the calves beginning at one month of age and at 60-day intervals, reduced calf losses from 15.3% to 4.2% and slighlty increased adjusted calf weaning weight.[10] Unfortunately, the cause of the calf mortality in that study was not determined. Therefore, it is difficult to explain the possible pathogenesis of the diarrhea and unthriftiness apparently due to subclinical selenium deficiency. In our epidemic, there was no laboratory evidence of a selenium deficiency in the calves. Although there was laboratory evidence of a vitamin E deficiency there is no published evidence of which we are aware that a vitamin E deficiency in calves can be a cause of diarrhea as it occurred in these calves.

The principal function of vitamin E is as an intracellular antioxidant.[2,5] It interacts with selenium-containing glutathione peroxidase to prevent the oxidative breakdown of tissue membranes associated with the hydroperoxides of polyunsaturated fatty acids. Lipid peroxides are produced particularly during the breakdown of polyunsaturated fatty acids. The functional combination of selenium and vitamin E helps to prevent damage.[7] The primary lesion usually involves a breakdown in the structure of cell walls, most commonly muscle tissue. The predominant lesions vary according to species involved. Young cattle with vitamin E/selenium deficiency develop nutritional myopathy; young pigs develop microangiopathy. In recent years, it has been demonstrated that vitamin E has an important role in immunity to infectious diseases. We are not aware of any published evidence that vitamin E deficiency in young calves can suppress the immune mechanism sufficiently to result in enteropathy and diarrhea. A deficiency of selenium has been shown to inhibit resistance to microbial and viral infections, neutrophil function, antibody production, and proliferation of T and B lymphocytes in response to

Table 4. Results of Diagnostic Testing Done on Samples Obtained During the May 29 Herd Visit from 8 Selected Calves

Calf I.D.	Serum CPK (U/L)	Serum AST (U/L)	Fecal Virology and Parasitology	Fecal Bacteriology	BVDV Isolation	BVDV Serology
16	318	77	NSF	NSF	negative	low titre
28	226	107	NSF	1+ oocysts	negative	low titre
48	534*	73	NSF	NSF	negative	no antibody
10	1254*	102	NSF	NSF	negative	no antibody
11	1162*	212*	NSF	NSF	negative	low titre
12	285	91	NSF	1+ oocysts	negative	low titre
18	321	45	Corona-like?	NSF	negative	moderate titre
42	233	48	NSF	NSF	negative	high titre

Serum CPK - marked values are above the normal range (normal 0 - 350)
Serum AST - marked value is above the normal value (normal 46 - 118)
Fecal Virology - no significant findings (NSF)
- coronavirus-like particles (corona-like)
Fecal Bacteriology - no significant findings (NSF)
BVDV Isolation - Bovine Viral Diarrhea Virus (BVDV) isolation
BVDV Serology - Bovine Viral Diarrhea Virus (BVDV) serology

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EXAMPLES:

Dose (5 mg/kg)	Dose (10 mg/kg)	Cattle Weight
2.5 mL	5.0 mL	109 lbs.
5.0 mL	10.0 mL	217 lbs.
10.0 mL	20.0 mL	435 lbs.
15.0 mL	30.0 mL	652 lbs.
23.0 mL	46.0 mL	1,000 lbs.

Under conditions of continued exposure to parasites retreatment may be needed after 4-6 weeks.
There are no known contraindications to the use of the drug in cattle.

WARNINGS: Cattle must not be slaughtered within 5 days following last treatment. Because a withdrawal time in milk has not been established, do not use in dairy cattle of breeding age.

CAUTION: Keep this and all medication out of the reach of children.

DOSAGE:
Cattle – 5 mg/kg (2.3 mg/lb) for the removal and control of:
Lungworm: *(Dictyocaulus viviparus)*
Stomach worm (adults): *Ostertagia ostertagi*
(Brown stomach worm)
Stomach worm (adults & 4th stage larvae)
Haemonchus contortus/placei (barberpole worm)
Trichostrongylus axei (small stomach worm)
Intestinal worm (adults & 4th stage larvae)
Bunostomum phlebotomum (hookworm)
Nematodirus helvetianus
(thread-necked intestinal worm)
Cooperia punctata and *C. oncophora*
(small intestinal worm)
Trichostrongylus colubriformis (bankrupt worm)
Oesophagostomum radiatum (nodular worm)
Cattle – 10 mg/kg (4.6 mg/lb) for the removal and control of:
Stomach worm (4th stage inhibited larvae)
Ostertagia ostertagi (type II ostertagiasis)
Tapeworm: *Moniezia benedeni*

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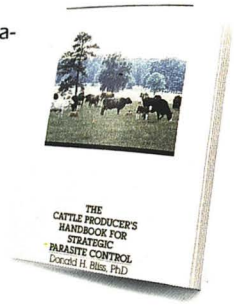

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mitogens.[13] Most of the evidence is based on research done in laboratory animal species but recent observations indicate a relationship between low selenium status in dairy cattle and an increased incidence of mastitis.[14]

The first calves to become diarrheic were those born from the young cows. They were the first calves to be turned out to pasture. According to the owner the calves selected for treatment of the diarrhea were those calves that "did not look right". Some of these calves had fecal staining of the perineal region and/or abnormal feces, and the owner believed that the diarrhea was the cause of the apparent illness. In spite of the therapy described previously, about 55% of the calves did not recover and subsequently died. The remainder of the calves were supplemented with parenteral vitamin E and selenium after the necropsies revealed evidence of muscular dystrophy. Although a few calves in this group were subsequently treated by the owner for diarrhea, none of them died. About 2 to 3 weeks after the initial cases, similar cases begin to show up in calves from the older cows. Following parenteral treatment of these calves at the time of the herd visit with vitamin E and selenium, no further deaths were recorded. However, it cannot be concluded that the provision of these nutrients prevented further cases of diarrhea without having done a controlled treatment trial.

It is probable that all of the calves in the herd (regardless of which cow group they came from) were at least marginally deficient in vitamin E, because the tissue samples submitted from all calves not given parenteral vitamin E and selenium contained marginal or deficient levels of vitamin E. Sudden unaccustomed exercise and handling of calves deficient in vitamin E and/or selenium can be a precipitating cause of muscular dystrophy.[1] It is possible that the increased exercise at pasture experienced by calves born to the young cows precipitated the disease in some calves. These were the calves noted by the owner as "not looking right". If vitamin E deficiency was the underlying cause of their illness, even the most aggressive therapy for neonatal diarrhea would be unsuccessful unless they were supplemented with vitamin E to prevent the occurrence of muscular dystrophy. The repeated process of catching and treating the calves may actually have precipitated the muscular dystrophy.

The calves from the older cows were not affected until 2 to 3 weeks later. This may have been because they were still housed in the corral. Without much opportunity for the increased exercise experienced by the other group of calves, it may have taken longer for the vitamin E reserves in these calves to become depleted and for them to exhibit signs of disease.

The occurrence of nutritional muscular dystrophy in calves which are deficient in vitamin E but with adequate levels of selenium is thought to be uncommon because of the expected reciprocal protection provided by the two nutrients.[1] However, recent experimental studies revealed that muscular dystrophy can occur in calves deficient in Vitamin E but adequate in selenium.[6] Recent observations in sheep in this clinic (B. Blakely, unpublished) suggest that when both nutrients are deficient the lesions of muscular dystrophy are more widespread and severe than when only one nutrient is deficient. This supports the long held view that the two nutrients cross protect to a certain extent. However, the occurrence of the disease in this herd with adequate levels of selenium suggests that selenium cannot fully replace a low vitamin E status in terms of disease. There is an absolute requirement for vitamin E.

A primary deficiency of vitamin E, without a concurrent deficiency of selenium, is not commonly reported in western Canada. Although cereal grains, green pasture and well-cured fresh hay generally contain adequate amounts of vitamin E, the content of vitamin E in mature grasses and legumes is markedly reduced and can fall to as low as zero. Diets which are rich in unsaturated fatty acids, such as fish meal used as a protein supplement, linseed oil, soybean oil and corn oil have all been implicated in the pathogenesis of muscular dystrophy.[1] Fresh spring grass can also have high enough levels of these unsaturated fatty acids, particularly linolenic acid, to precipitate muscular dystrophy in unsupplemented or marginally deficient calves. It is unlikely that this is a factor in this case because there was very little evidence of new grass growth observed during the herd visit. It is unfortunate that the owner had used all of the supplemental feed that was being fed to both groups of cows. In general, the vitamin E intake by the cattle was low and, also, the stability of the vitamin E in the mineral mixture is likely poor. By the time the cattle consumed the product, the 500 I.U./kg was probably considerably less.

Nutritional muscular dystrophy in beef calves due to a deficiency of vitamin E and/or selenium can be prevented by supplementation of the diet during pregnancy. Selenium is transferred from the pregnant female to the fetus via the placenta. The provision of a free-choice salt mineral mixture containing selenium at a level of 90 mg/kg on a year round basis will maintian the selenium status and glutathione peroxidase (GSH-Px) levels at adequate levels.[3,8] The delivery of adequate levels of vitamin E to the pregnant cow by including the vitamin in salt-mineral mixtures has not been as successful because of the cost of the vitamin and its loss of potency due to oxidation. Cattle which do not receive selenium and vitamin E in their diets during pregnancy may be injected with commercially available preparations of selenium and vitamin E between the 5th and 8th months of pregnancy. However, the duration of adequate levels of selenium and vitamin E in tissues and blood following injection is not well know. In one study, the subcutaneous injection of pregnant beef cattle in the last trimester of pregnancy with 36 mg of selenium as sodium selenite, and 816 I.U. of vitamin E did not increase the plasma levels of selenium between the time of injection and parturition which varied from several days to several weeks.[9] These preparations can also be given to calves at

prophylactic levels beginning at about one month of age and at 30 to 40 day intervals until weaning in geographical areas where the occurrence of the disease is common. It is noteworthy that the two calves, Nos. 18 and 42, which had been treated with injectable vitamin E and selenium on May 26, had remarkably high plasma levels of selenium and vitamin E three days later. Sustained release intrareticular selenium supplements are also available which release 3 mg of selenium daily as sodium selenite and last for 120 days.[12] The selenium readily crosses the placenta to the fetus and the concentrations of selenium in colostrum of treated cows are significantly increased.

Recommendations

The following recommendations were made to prevent the occurrence of nutritional muscular dystrophy due to a deficiency of vitamin E and/or selenium, and for the control of acute undifferentiated diarrhea in young calves.

1. Supplementation of cows throughout the year with a good quality mineral supplement containing selenium and vitamin E, and used in accordance with the manufacturer's recommended feeding and mixing instructions.[3] If dietary supplementation is not possible or is impractical, the parenteral administration of selenium and vitamin E to the pregnant cows between 5 and 8 months of pregnancy is recommended. Sustained release intrareticular boluses may also be considered.[12]

2. If the pregnant cows do not receive an adequate intake of selenium and vitamin E, the parenteral administration of the two nutrients to all calves at about one month of age is recommended. This may have to be repeated at strategic times or every 30 to 40 days until the calves are older and consuming a mineral mixture containing the nutrients.

3. The selenium and vitamin E status of the cows in late pregnancy, and the calves at about one month of age, can be monitored by laboratory evaluation of blood samples taken from randomly selected animals.

4. The cows and heifers should be vaccinated during pregnancy with a vaccine containing *E. coli K99+*, rotavirus and coronavirus for the control of acute undifferentiated diarrhea of calves.

5. Diarrheic calves should be identified early and treated with oral electrolyte solutions in quantities sufficient to correct dehydration and maintain acid-base balance until recovery occurs. If antibiotic therapy is used, parenteral injection is preferable to oral medicaton. Diarrheic calves with clinical evidence of severe dehydration require intensive intravenous fluid therapy and veterinary attention.

6. Every calf which dies of uncertain causes should be submitted to the diagnostic laboratory for pathologic examination.

7. For the control of diarrhea of beef calves, the management procedures should include control of the population density in the calving area to avoid overcrowding and contamination of the ground surfaces, and the movement of cow-calf pairs from the calving area 24-48 hours after the birth of the calf to a nursery pasture. Ensuring that every calf receives a liberal quantity of colostrum within a few hours after birth is also of primary importance.

8. Records such as calf birth dates, calving ease, disease, treatment and diagnosis should be maintained by the owner.

Summary

An epidemic of acute diarrhea in 2 month-old beef calves is described. The morbidity rate was estimated to be about 40%. The case fatality rate was approximately 55% in spite of intensive therapy including antimicrobials and oral and intravenous fluids. Weakness and recumbency were typical clinical signs in affected calves, and initially were attributed to the effects of the diarrhea and dehydration. However, clinico-pathological examination of affected calves revealed unexpected evidence of skeletal and myocardial muscular dystrophy which may have complicated the effects of the diarrhea and accounted for the high fatality rate. The tissue and plasma levels of vitamin E were at deficient levels; the selenium levels were adequate. The amount of mineral vitamin supplement fed to the cows was inadequate; the concentrations of vitamin E and selenium in the feed were unknown. The cause of the diarrhea was not determined but viral enteropathy was originally suspected. Investigation of the herd revealed the presence of less than optimal management procedures for the control of diarrhea in beef calves. The possibility that the diarrhea could have been caused by selenium and/or vitamin E deficiency is discussed.

References

1. Blood, D.C. & Radostits, O.M. Veterinary Medicine. A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses. 7th Edition. Bailliere & Tindall. 1989. London. 2. Putnam, M.E. & Comben, N. Vitamin E. Vet. Rec. 121:541-545. 1987. 3. Koller, L.D., South, P.J., Exon, J.H. & Whitbeck, G.A. Selenium deficiency of beef cattle in Idaho and Washington and a practical means of prevention. Cornell Vet. 73:323-332. 1983. 4. National Research Council. Selenium in nutrition. National Academy Press. Washington, D.C. 1983. 5. Rice, D. & Kennedy, S. Vitamin E: Function and effects of deficiency. Br. Vet. J. 144:482-496. 1988. 6. Walsh, D.M., Kennedy, S. & Kennedy, D.G. Tissue concentrations of vitamin E, selenium and thiobarbituric acid reactive substances in ruminant calves depleted of vitamin E, or selenium or both. Proc. Nutr. Soc. 50:68A. 1991 7. Braun, U., Forrer, R., Furer, W. & Lutz, H. Selenium and vitamin E in blood sera of cows from farms with increased incidence of disease. Vet. Rec. 128:543-547. 1991. 8. Swecker, W.S. & Whittier, W.D. Current topics for bovine practitioners. Selenium supple-

mentation of cattle. Amer. Assoc. Bovine Practitioners. October, 1991. 9. Cohen, R.D.H., King, B.D., Guenther, C. & Janzen, E.D. Effect of prepartum parenteral supplementation of pregnant beef cows with selenium/vitamin E on cow and calf plasma selenium and productivity. Can. Vet. J. 32:113-115. 1991. 10. Spears, J.W., Harvey, R.W., Segerson, E.C. Effects of marginal selenium deficiency and winter protein supplementation on growth, reproduction and selenium status of beef cattle. J. Anim. Sci. 63:586-594. 1986. 11. Puls, R. Veterinary trace mineral deficiency and toxicity information. Ottawa. Information Services. Agriculture Canada Publications 5139. 1981. 76-78. 12. Campbell, D.T., Maas, J., Weber, D.W., Hedstrom, O.R. and Norman, B.B. Safety and efficacy of two sustained release intrareticular selenium supplements and the associated placental and colostral transfer of selenium in beef cattle. Amer. J. Vet. Res. 51:813-817. 1990. 13. Kiremidjian-Schumacher, L. & Stotzky, G. Selenium and immune responses. Environmental Research. 42:277-303. 1987. 14. Erskin, R.J., Eberhart, R.J. & Scholz, R.W. Experimentally induced *Staphylococcal aureus* mastitis in selenium deficient and selenium supplemented dairy cows. Amer. J. Vet. Res. 51:1107-1111. 1990.

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Attention Please!

The Proceedings of the 1992 Convention in St. Paul, Minnesota on August 31 – September 1, will be published for distribution to the registrants at the meeting.

Therefore, the 1992 BOVINE PRACTITIONER will NOT be published.

A supplement to the Proceedings will be published later in the Fall.